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TERRIBLE EXPLOSION OF ACETYLENE IN PARIS.

A TERRIBLE accident occurred on October 17 at Mr. Pictet's acetylene manufactory. A cylinder of liquefied acetylene exploded in the gasometer building, a special structure, about thirty feet in height, standing behind the main works, from which it was separated by a court.

There were but two workmen in the building at the time, Leon Secret and Pierre Pautre, who were occupied in testing some cylinders that had recently been returned to the works and that were thought to be empty. All at once the wall of the building fell in, killed the two workmen and crushed everything in the vicinity. Near the gasometer building was a smaller structure containing the boilers. Pierre Renault, the fireman, sixty years of age, who had just entered it, was slightly wounded.

In all the other buildings of the works there remained not a single pane of glass in the windows. The finely crushed fragments of glass covered the earth to a depth of half an inch. The neighboring property did not escape either, for the yards were strewn with fragments of glass and with pieces of wood thrown to a distance by the explosion. It is a miracle that the gasometer near which the workmen were operating did not explode in its turn and blow up the entire quarter.

The explosion caused great excitement in the entire neighborhood. A crowd collected, and was held in check with great difficulty while M. Garnier, commissary of police, and M. Goulier, peace officer, were making the preliminary inquiries.

The industrial manufacture of acetylene gas is quite recent. It was in 1892 that M. Moissan produced in his electric furnace the pure carbide of calcium which, in contact with water, gives an immediate disengagement of acetylene.

The illuminating properties of the gas were soon made known, and it was thought that a practical application might be made of it; but opinions differed as to the method of using the gas. Some thought that the acetylene should be delivered in the form of gas, while others (M. Pictet in particular) were of the opinion that it should be liquefied by compression and delivered for consumption in this state.

According to the police inquiry, it is presumable that at the moment of the explosion Pautre was engaged in examining a stop cock, and that Secret, standing at his bench, was trying to loosen the nut of the cylinder cock, that he had fastened in a vise, probably not having succeeded in unscrewing it with the ordinary wrench. We are indebted to Le Monde Illustré for the cut and particulars.

AN EXPLOSION OF ACETYLENE AT PARIS.

TOOLS IN ANCIENT GREECE.

As the mechanical powers are modifications of the lever, it might be said that all tools are derived from the knife. The savage who first observed that every time a piece of flint was broken the edges of the fracture were sharp enough to inflict a wound on his hand, and who used his knowledge to injure his neighbors and to operate on natural objects, was a logician who deserved to be remembered. A visit to any collection of prehistoric remains excites surprise at the variety of production which was accomplished by the rudest implements. But, as we have suggested, the knife, if slow in its operations, is effectual, and to some extent resembles the American series of tools which are inclosed in one handle. The Swiss peasants and those of the Black Forest mainly depend on their knives for the production of intricate carvings.

The relation between tools and what is formed by their aid is so close that in every museum or private collection it would be an advantage if they were introduced as affording the clearest explanation of the characteristics of the exhibits. Models or drawings would, of course, serve as well as originals. In that way it would be apparent that progress in industry depends to a large extent on improved tools. The painter's implements and the potter's wheel are examples of the retention of what is ancient, and in other industries handwork is superseded by machines. But in the majority of cases delicacy of treatment is rarely attained by anything possessed by the primitive worker. Exception must, of course, be made in those cases where the most perfect of tools, that is, the human hand, can be employed without restriction.

The primitive Greek races, like the rest of men, employed stone implements. At a later time the people were probably ashamed of those experiments, and as soon as evidence is forthcoming we find it proves the use of metals for tools. The anvil, as the foundation for metalworking, would appear from Homer to have been looked on with a sort of respect, and several varieties are suggested. They were not considered out of place on Olympus, for Jove, when enraged with his wife for her wiles against the Trojans, bids Juno remember how he once hung her out of heaven with anvils attached to her feet, while the gods sympathized but dared not interfere. Vulcan found it advantageous to use sometimes colossal anvils, and on other occasions, for fine work, such as trinkets, clasps, rings and chains, there were smaller varieties. The god was represented as a careful artificer, who was proud of the state of his tools, for it is said when leaving off work he carefully collected them and placed them in a silver chest. Apparently the form of the anvil did not differ much from the type now approved, but, instead of resting on the top of a wooden block, a hollow was made in the wood to receive it.

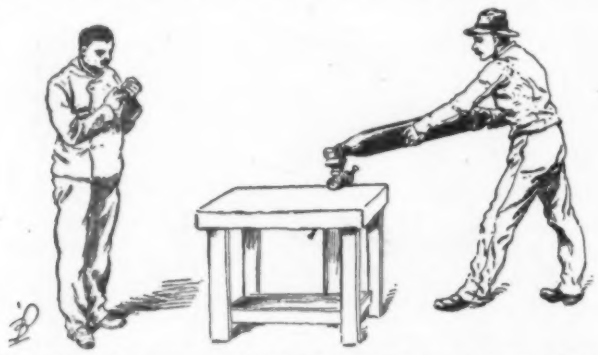
As there was more than one sort of anvil, there must have been several varieties of hammers. Homer mentions two (one probably was a sort of sledge), and in other writers there is reference to some which he ignored. For instance, a golden hammer is introduced in an epigram in the "Anthology," which could hardly be intended to operate on another metal. The smith's bellows differed from the modern, and was a noisy apparatus in its aspirations and expirations. The Greeks in Homer's day were not, it is supposed, acquainted with charcoal, but dried wood may have served as a substitute.

The use of knives and hammers would lead to the introduction of the hatchet, which combines, to some extent, their properties. It was used as a weapon as well as a tool. From what is said occasionally it might be concluded that a Greek was as dexterous with his

hatchet as a modern Japanese with his adz. Calypso gave both to Ulysses. The ax was double edged, with a handle of olive wood, which was finely adorned. One handle may have served for several axes, for a test offered by Penelope to the suitors was to send an arrow through the holes for the handles in twelve axes, a trial which Ulysses alone accomplished.

According to the tradition preserved by Pliny, the saw was suggested by the leaves of a plant; others ascribe the origin to a part of an insect or a fish. It is remarkable that in no passage in Homer is the tool described. When Penelope is said to be "fairer than the ivory fresh from the carver's hand," there are some interpreters who would say she was as fair as ivory plates which the saw had cut. Instruments for boring and piercing were also known.

A Greek gentleman in Homer's time was able to use all tools efficiently. No doubt the standard for the workmanship was only what was possible when division of labor as a principle was unknown and specialists were few. When Ulysses tells his wife that to make a bedchamber he cut down the greater part of an olive tree, and left the lower part standing in order that it might serve as a foundation for the bed, we can infer the shifts to which ignorance of construction forced men. In those days there was likely to be some of the affinities between dwellings and boats which were to be seen in Dan Peggotty's wondrous house in Yarmouth, especially in places which were close to the sea. Ulysses does not hesitate, when he gains a chance, to construct a boat; Calypso gives him the materials, and in four days it is launched. In such cases finish was impossible, and as long as a house or a boat could be kept from falling to pieces, the aim of the builder was realized.—The Architect.



SUPPOSED POSITION OF THE WORKMEN WHEN THE EXPLOSION OCCURRED.

TURBO-ELECTRIC GENERATORS FOR ALKALI WORKS.

OUR illustration annexed shows one of two large turbo-generators constructed by Messrs. C. A. Parsons & Company, Heaton Works, Newcastle-on-Tyne, for the Electro-Chemical Works of St. Helens, for the generation of electric current for the decomposition of salt into chlorine and caustic soda. The plants have each an output of 3416 amperes at 120 volts, or 410 kilowatts; they work with steam at 150 lb., and exhaust into jet condensers.

The steam turbine is of the multiple compound type, with the flow of steam parallel to the axis, and contains in all 80 rows of moving blades and the same number of rows of fixed guide blades. These turbines are designed for a ratio of expansion of 200 fold, and to work with extreme economy of steam, the guarantee by the makers being 15 lb. of superheated steam per electrical horse power per hour.

The dynamo shaft is directly coupled to the motor shaft by a square sleeve coupling, and carries two armatures of the ring type, each for 1,708 amperes, working in parallel on to the terminal bars; there are 36 sections in each commutator and the same number of convolutions on each armature; eight massive brushes collect the current from each commutator. Separate magnets of wrought iron are provided for each armature, allowing of easy adjustment by the yokes for equalizing the current between the armatures. The magnet coils are shunt wound, and the magnetizing current is only 20 amperes or under 0·6 per cent. of the output. The speed of revolution is 3,000 per minute.

The lubrication is maintained by an oil pump, worked from the engine, and the oil is passed through a coil surrounded with water, on its way to the bearings. A double beat valve, worked on Messrs. C. A. Parsons & Company's system, for admitting the steam in puffs, is electrically controlled by a shunt solenoid from the terminals of the machine, the variable motion of the valve being obtained from the compound motion derived from an eccentric worked by worm and wheel from the engine shaft, and the shunt solenoid through a compounding lever; the gear is very simple and easily controlled, and maintains the electrical pressure with unusual steadiness. A safety or excess speed governor is also provided of the usual centrifugal type, as an additional precaution against excess of speed.

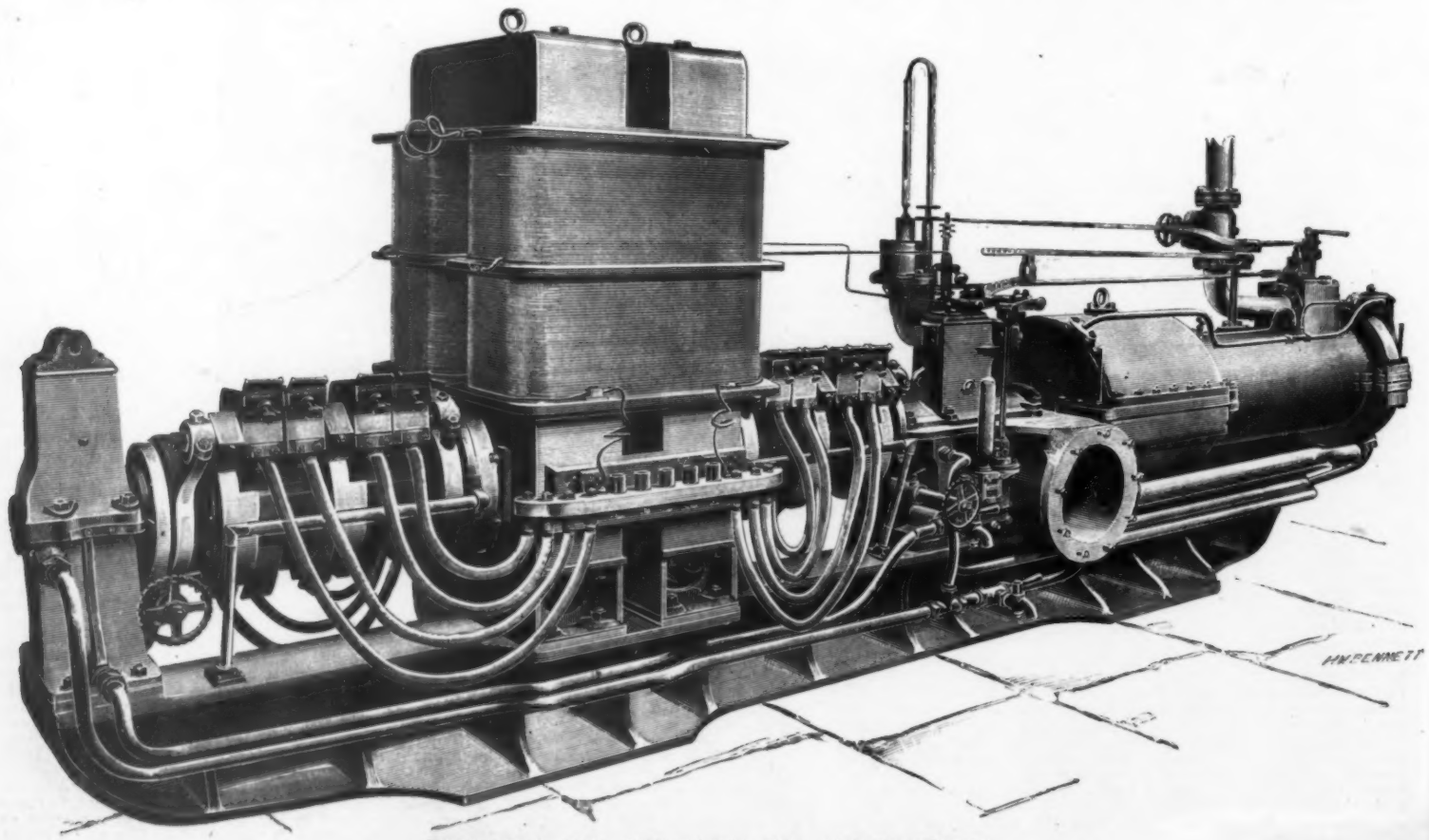
The bearings are of Messrs. C. A. Parsons & Company's oil-cushioned type, and the bearing surfaces are gun metal or steel.

The turbines were designed to work with superheated steam, the superheaters to be heated by the waste gases from the caustic pots, but so far these have not been fitted.

The condenser plant, provided by the same contractors, is in duplicate, one to each turbo-electric generator. Each plant has two compound air pumps, with cylinders 8 in. and 18 in. in diameter and 9 in. stroke, placed above, and a separate water pump on the same rod, with plunger 14 in. in diameter, is placed below for receiving the injection water. The pumps are connected by return rods to the crossheads of a compound condensing engine, cylinders of 8¼ in. and 14½ in. diameter: the feed pumps are also worked from the same crossheads. The vacuum obtained is about 29 in., with an injection volume of 40 times the feed.

The total weight of each plant, consisting of steam turbine and dynamo, is 14 tons, and the weight of each double armature complete is 30 cwt.

We are indebted to London Engineering for the cut and description.



TURBO-ELECTRIC GENERATOR FOR ALKALI WORKS.

PRESERVING SMALL SKINS.

As the camping season is at hand, and many of our young men may take to the mountains, prey upon the

THE ACETYLENE CYLINDER.

inhabitants and wish to preserve mementoes of the slaughter, the following directions from the Country Gentleman may do to put in their gun cases:

Clean off all the flesh and fatty matter on the flesh side, after which wash that side with a strong lye made from wood ashes, and follow that washing very soon with one of sperm oil. Rub such parts as are not

soft enough until they are, and the work is done. Skins of animals of the squirrel size may be tanned in from five to ten minutes; of the cat and rabbit, in ten to fifteen; lambs in fifteen to twenty and calf skins in thirty minutes. The lye must not be allowed to work too long, or it will consume the fiber, and, eating through the skin, will loosen the hair. The design is to have the lye consume or destroy the gluten only, and to use the oil to preserve the fiber and hair, all of which will be realized if the lye and oil are properly used. Rubbing the hair with dry sawdust will cleanse it and give it a bright, glossy appearance.

Stretch the skin on a piece of thick plank and tack the edges, the flesh side being uppermost. Then scrape off all the flesh, fat, etc., being careful to avoid cutting the skin. Then mix equal parts of salt and alum, finely powdered, with rye flour into a paste sufficient to cover the skin a quarter of an inch thick. If there is only one, it should be doubled and pressed by laying a shingle or piece of board upon it, with a weight upon this. If there are several, they may be laid in pairs, the flesh sides together and then pressed. In this state they are to lie for ten days, when for a thick skin the dressing should be repeated. When the skin is fully "tawed" (not tanned) it is shaken out, and again stretched and rubbed with a piece of chalk, and then with pumice stone until it will take in no more chalk, and is quite dry and nice. It is then well shaken and beaten, and is ready for use. Mole skins dressed in this way make beautiful gloves or trimmings.

First soak the skins in cold water until soft. (If just taken off, they will not need soaking.) Then scrape the flesh and grease off. This can be done over a half round post. Set one end on the ground and have the other as high as the hips. Place the skin over the post so as to lean against the end of the post, and hold the neck of the skin. In place of a beam knife, a long carving knife can be used by winding a cloth on the point, so both ends can be held to scrape the skin with the middle of the knife. Next make a liquor by dissolving one pound of alum and one pound of salt together in two or three gallons of water. Set the liquor to cool and put the skins in. Stir them so that the liquor reaches all parts of the skin, and let them remain in the liquor from six to ten days, or longer, if in no hurry for the skins. Then dry them in a cool place.

Dampen them by hanging up in a cellar overnight, and then stretch them out. This can be done over a spade turned handle down. (Or a stretcher can be made by nailing a piece of 1¼ inch plank, 2½ feet long by 8 inches wide, in the center of a 2 inch plank, 10 inches wide by 3 feet long, in the form of a T, and sawing a slit in the top of the upright piece and fitting in a piece of iron or an old hoe blade.) To clean the fur, put six or eight inches of hardwood sawdust (the finer the better) into the bottom of a barrel and put the skins in, putting more sawdust among and over them; then stand in the barrel and tread them until the fur is clean. The liquor will keep a long time, and as used can be renewed by adding alum and salt.

Take of saltpeter one part; salt, two parts; alum, two parts; pulverize finely and mix thoroughly. From the skins remove all fleshy parts; if they have been dried, you must soak them in water to soften them. Then give the skins a thin coating of the mixture, turn the sides in, roll them up, and lay aside for a few days. The thicker the skin, the longer they must lie. A squirrel requires about three days and a rabbit skin would require, probably, four or five, and perhaps six days. A little practice will be the best teacher in this. Now take them and rinse thoroughly, removing all the mixture; wring them out well; keep rubbing them between the hands and pulling them in every direction until perfectly dry. By following the above directions you will have skins as soft as velvet.

THE FIRST BICYCLES.

THE history of bicycling, which is not generally known, we have had an opportunity of studying by means of some unpublished documents. We borrow from M. Baudry de Saunier some historic data that he has collected and published in his excellent book entitled "Le Cyclisme Theorique et Pratique":

At the end of the seventeenth century, in 1693, Oza-

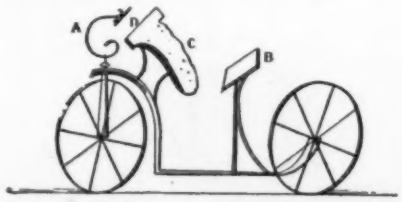


FIG. 2.—DETAILS OF A DRAISIENNE FOR LADIES.

nam, a member of the Royal Academy of Sciences, speaks of a mechanical carriage owned by one of his friends, a physician at Rochelle. "A lackey," says he, "gets on behind and causes it to move by bearing upon two pieces of wood that communicate with two wheels that actuate the axle of the carriage."

It was not till 1790 that a certain individual comprehended that simplicity was the master mover of a machine designed to facilitate the locomotion of a person by himself. Upon his first conception of this, Mr. De Sivrac put his finger upon the most powerful motor of the human body, i. e., the leg, and employed this motor alone for the propulsion of his machine. The apparatus devised by M. De Sivrac, the "celerifere" (from Latin celer, "quick," and fero, "I bear") consisted of three elements of wood, a strong beam and two wheels. The beam was provided in front and behind with a fork, between which the wheel revolved. A saddle—a cushion—upon the back of this funny animal, then go ahead!

In 1818 Baron De Drais, of Sauerbon, an agriculturist and engineer, modified the celerifere as follows:

The front was not mounted directly upon the beam that supported the rider, but was jointed upon it by a pivot that allowed it to swing to the right and left. Thereafter there was no longer any need, as there was formerly, of punching the head of the machine on the right or the left in order to steer it. An easily maneuvered steering rod turned the front wheel (which became the steering one) into whatever road the rider's fancy chose.

Baron Drais got intoxicated in the contemplation of his machine, gave it the name of draisienne, and ordered one of his servants to exhibit it to the loungers in the Tivoli Garden. But, either on account of timidity or want of training, the servant, with great exertions on the part of his hams, succeeded only in making the children run in pursuit of him. Hooted at, frightened, and losing his head, he went home to his master, who was exasperated at the miscarriage. The caricatures that rendered the draisienne ridiculous drove the baron to despair; so he gave up his velocipede, expatriated himself, and went to live in a convent at Carlsruhe. He died in 1851, isolated from the entire world. We must not judge Baron Drais severely, for he preserves an important name in the history of bicycling. It must be recognized that the draisienne was long neglected, but the English at length took it up and used it, although they criticised the apparatus, the weak point of which they found in its construction of wood. The wood used in it had not much strength and was not durable.

The English soon abandoned this material (which became swollen through rain and cracks in its joints) and employed iron. They manufactured improved velocipedes which they presented to the public and which had

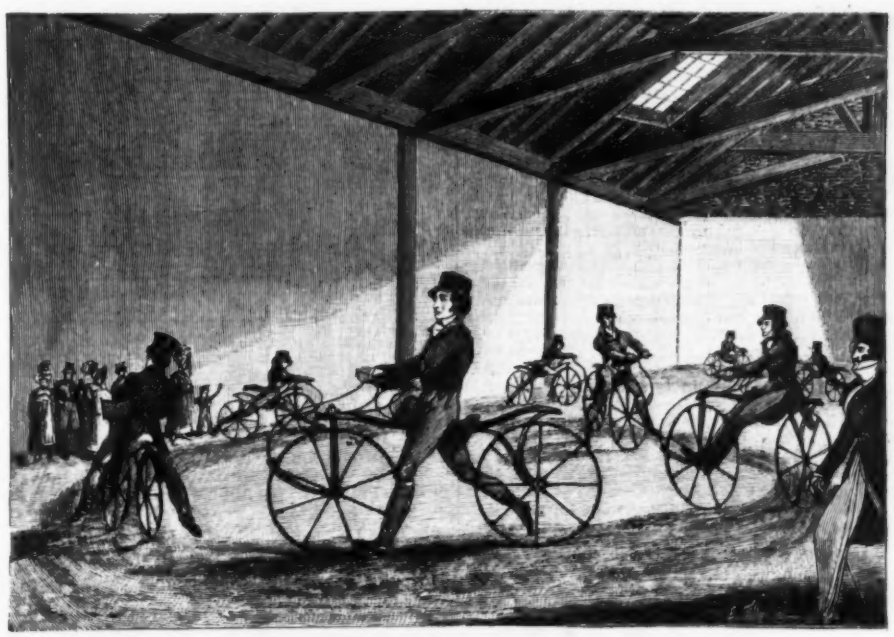


FIG. 1.—DRAISIENNE RIDING SCHOOL AT LONDON IN 1819.

FIG. 3.—LADIES RIDING THE MECHANICAL HORSE IN 1819.

FIG. 4.—GREAT HOBBY HORSE RACE, APRIL 4, 1819.

much success from the year 1818 under the name of "pedestrian horses" or "hobby horses" (Fig. 1). What follows will show our readers that the hobby horse soon came into great favor.

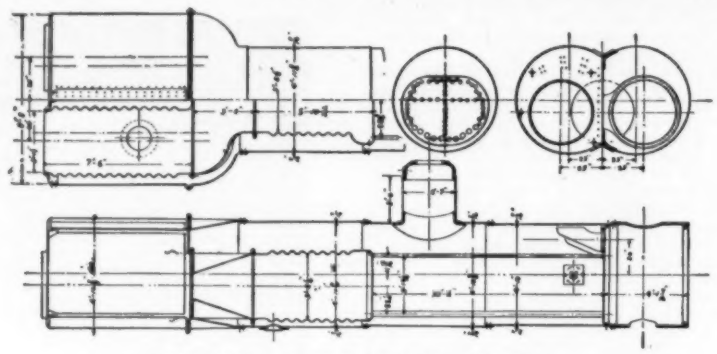
This machine, which is of the simplest construction, is supported by two light wheels running in the same line. The front wheel revolves upon a pivot which, through a short lever, serves for steering either to the right or the left. The hind wheel always preserves the same direction. The rider seats himself upon a saddle placed upon the back of the horse, midway between the two wheels. The feet are placed flat upon the ground, so that in order to give motion to the machine at the first step that is made, the heel must be the first part of the foot that touches the ground, and so on with the other foot alternately as if one were walking upon his heels. Care must be taken to begin the motion very gently. In front of the rider there is placed a cushion as a rest for the arms while the hands hold the lever that steers the machine. It is necessary, too, to incline upon the proper side when the opposite arm is pressing the cushion.

Fig. 2 gives the details of the draisienne for the use of ladies. This machine is an ingenious modification of the first one that was constructed, and was more easily used by ladies. The person who uses this hobby horse seats herself upon the board, B, and leans over upon the cushion, C, which is well stuffed. At the top of this cushion there is a balanced lever, D, upon which the arms rest if the machine inclines too much to the one side or the other. In this position the frock floats freely over the ground, which the feet touch as if one were walking; but it is necessary to push with the legs. In front there is a small handle bar mounted upon a double axis whose branches are so arranged that the two hands placed at the ends of the handle bar suffice to turn the steering wheel to the right or left. This system was very remarkable. It was used by ladies in 1819, and afforded them great enjoyment.—La Nature.

THE STRONG LOCOMOTIVE OF 1889 AND 1896.

We present general views and the details of the A. G. Darwin as she was originally built in 1889 and as she now stands with the many changes which have been made in her design to turn her into the Strong balanced compound, as she will henceforth be known.

The typical 8 wheeled American locomotive of the present day is but little different from the machine of thirty years ago. The old fashioned slide valve of the D type has been retained, the boiler has for many years been of the tubular character, of so definite construction that the term locomotive boiler represents a well recognized structure. For a long time locomotive boilers were noted for carrying high pressures, but now they are distanced in the race, even the large marine boilers on steamships equaling or exceeding them in this respect.



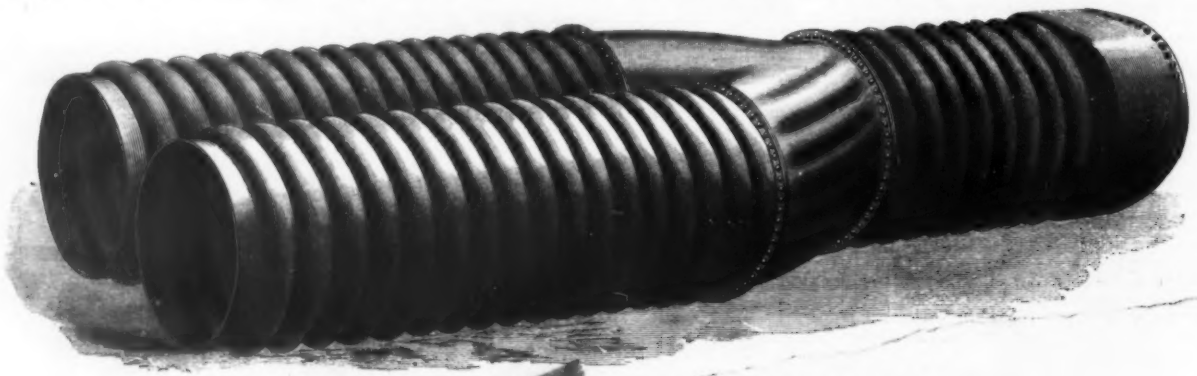
DETAILS OF THE STRONG BOILER.

The Strong engine indicates a departure in the construction of locomotives that is quite radical. The boiler and valve gear are of original design, and the results already achieved appear to be well in advance of the usual practice.

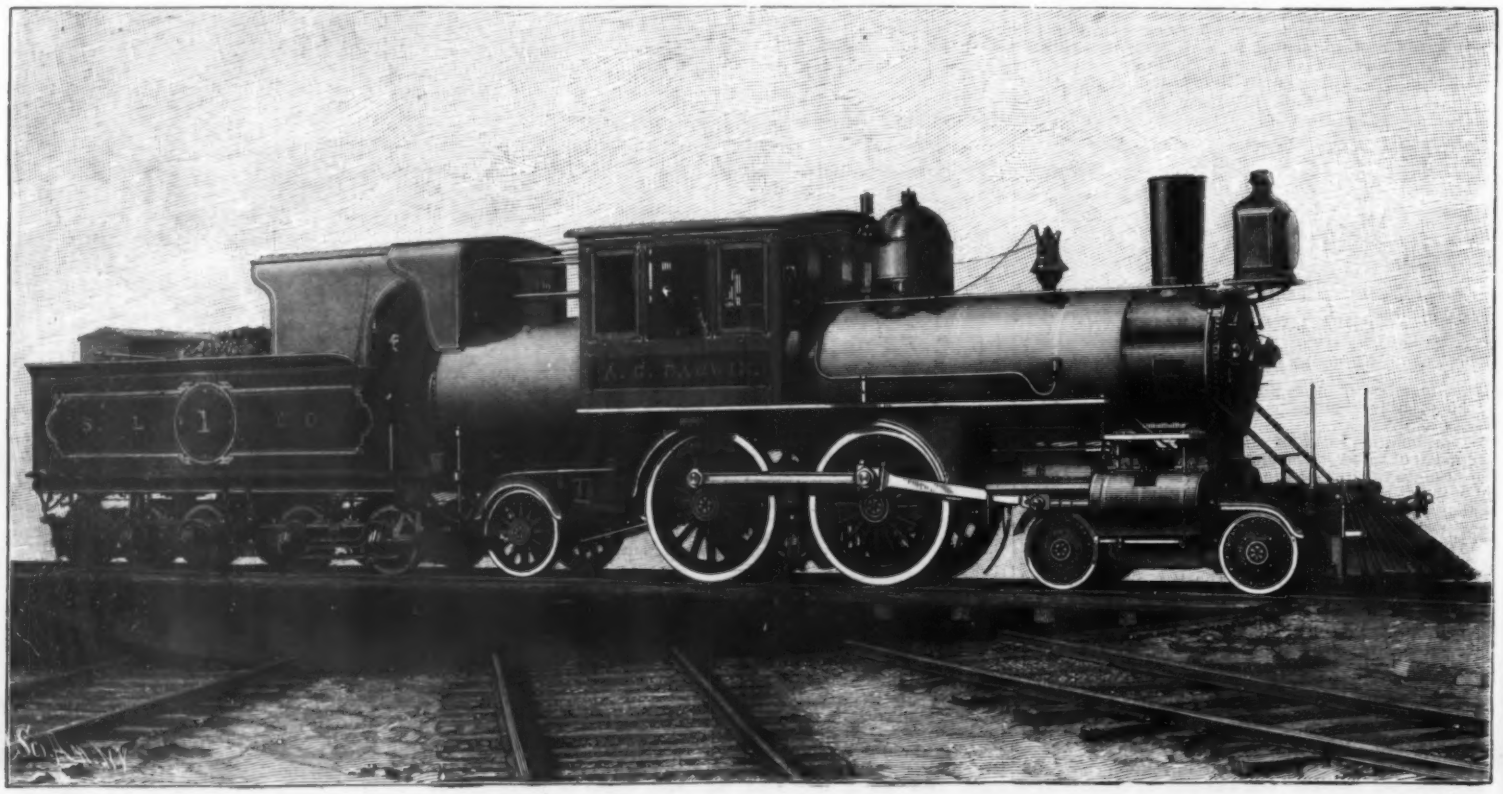
The boiler is bifurcated at the fire box end, forming two fire chambers which contains two grates. The fire boxes are joined by a single combustion chamber which forms the main division of the boiler. These parts are made of corrugated steel plates with welded longitudinal seams. The combustion chamber abuts against the tube sheet. Forward of this comes the main body of the boiler, traversed by the tubes, 235 in number. The boiler shell incloses the two fire boxes and the combustion chamber, being itself bifurcated. As far as possible, all the elements of the shell are cylindrical. The connecting portions between the barrel and the bifurcated portion are of generally spherical outline, so that the ends are the only flat portions. A flexible shell opposed to internal pressure would naturally take the cylindrical and spherical contour. Thus the steam pressure does not tend to change the shape of the shell, but all the strains resolve themselves into tension, except of course for the flat heads. These are strengthened by gusset plates, but the tubes supply the principal element of bracing, otherwise the boiler is unstayed. A man can have access to every portion of the interior around the fire boxes. By using flanged seams, hand riveting can be dispensed with. Much of the shell can be shaped by hydraulic pressure.

The two fires co-operate in burning the fuel. On one grate a very hot thin fire is kept, while a new fire is burning on the other. The latter gives off imperfectly oxidized gases which enter the combustion chamber. There they meet the hot flames from the other fire, and are completely consumed. The fires are made to alternate in these roles. Thus almost any kind of fuel may be burned by one engine. The absence of stays and crown bars gives the boilers a character of unity that adapts it to withstand the strains and jarring inevitably attendant upon its work. Where a boiler is to be subjected to torsional and transverse strains, as in locomotive practice, every stay is an element of weakness, only admissible to enable the flat surfaces to stand the internal steam pressure.

The corrugated furnace chambers have, as our readers know, been extensively introduced in marine boilers. They have effected important economy in this service, as higher pressures can be carried than with the old style flat sided structures. They have co-oper-



THE CORRUGATED FIRE BOXES AND COMBUSTION CHAMBER.



THE A. G. DARWIN AS ORIGINALLY BUILT; 1889.

Two 19 × 24 inch cylinders; 68 inch drivers; steam pressure, 160 pounds.

ated with the compound engine to bring down the coal consumption to the very low point it has now attained in good practice. Its introduction on a locomotive is a step in the right direction, comparable to compounding the cylinders.

The valve gear, which is an adaptation of the well-known Walshaert gear, so largely used in Europe, is designed to give an equal lead at all points of cut-off. The valves are of the gridiron type, working vertically, and they are operated in the reconstructed engine from the outside crankpin, which is seen in the illustration attached to the main driver. Motion is given by a connecting rod which is attached to a crank arm on the link shaft. The links have a fixed point of revolution, the blocks sliding in the links instead of the links on the blocks. The motion is thence transmitted to the rocking shafts of the valves, which will be seen located above the cylinders. The gear which is seen midway between the link blocks and the valves is operated from the crosshead and imparts the necessary lead and lap to the valves. The chief advantage claimed for this arrangement of valves and valve gear is that by providing large port areas (in this case as high as 11 per cent. of the piston areas) the steam has a very free admission and exit to and from the cylinders, and wire drawing, that most fruitful source of loss at high speed, is prevented.

The general dimensions of the A. G. Darwin were as follows:

Cylinders, 19 in. diam. by 24 in. stroke.	
Driving wheels, 68 in. diam.	
Total weight of engine with boiler full and coal on grates	188,000 lb.
Weight on both pairs of drivers	72,000 "
Weight on forward truck	34,000 "
Weight on trailing wheels	32,000 "
Grate surface	30 sq. ft.
Heating surface	1,650 "
Working pressure of steam	160 lb.
Wheel base of drivers	7 ft.
Total wheel base	29 "
Height above track, clearing everything	14 "
Total length of boiler	31 ft. 7/8 in.

It will be noticed that the engine has two cabs. A speaking tube is provided for communication between the fireman and engineer.

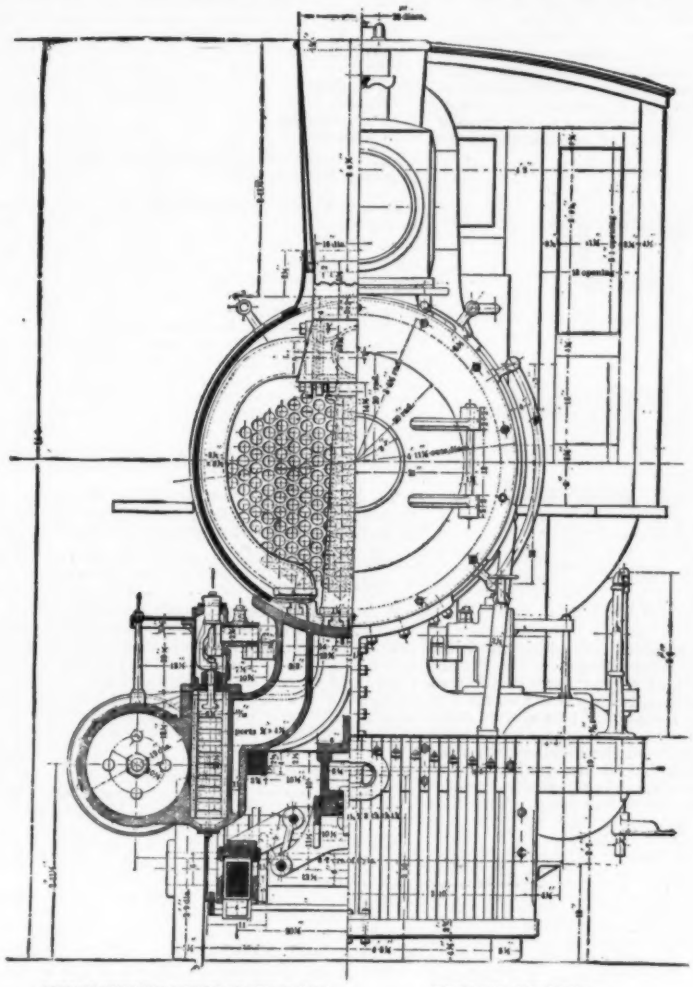
At the time of her appearance, about six years ago, this locomotive attracted great attention on account of her capacity for hauling heavy trains at express speed. Her performance on April 1 and 2 was considered to be the most remarkable run ever made by a locomotive on a regular train. On this occasion she hauled the New York, Lake Erie and Western Railway Company's morning express train continuously to and from Buffalo, a distance of 423 miles each way, arriving at the destination on time on both days in perfect order. The steam pressure was easily maintained to the blowing-off point during the trip. The difficulty in making a long run like this, which is ordinarily done by four engines each way, is due to a failure in maintaining steam pressure on account of the fire becoming full of ashes and clinkers and also to the inefficient use of the steam by the ordinary locomotive valve gear. The Strong valve gear gives the locomotive a reserve of power which enables it to recover easily from any ordinary delay that may occur on the road, and that tells to great effect in starting and hill climbing.

The train consisted of the following cars and weights, exclusive of locomotive and passengers: Jersey City to Port Jervis, 6 cars, including 2 Pullmans, weighing 132 tons; Port Jervis to Elmira, 7 cars, including 2 Pullmans, weighing 154 tons; Elmira to Hornellsville, 9 cars, including 3 Pullmans, 214 tons; Hornellsville to Buffalo, 7 cars, including 3 Pullmans, 209 tons.

Buffalo to Hornellsville, 9 cars, including 3 Pullmans, 233 tons; Hornellsville to Elmira, 11 cars, including 5 Pullmans, 335 tons; Elmira to Jersey City, 9 cars, including 4 Pullmans, 274 tons.

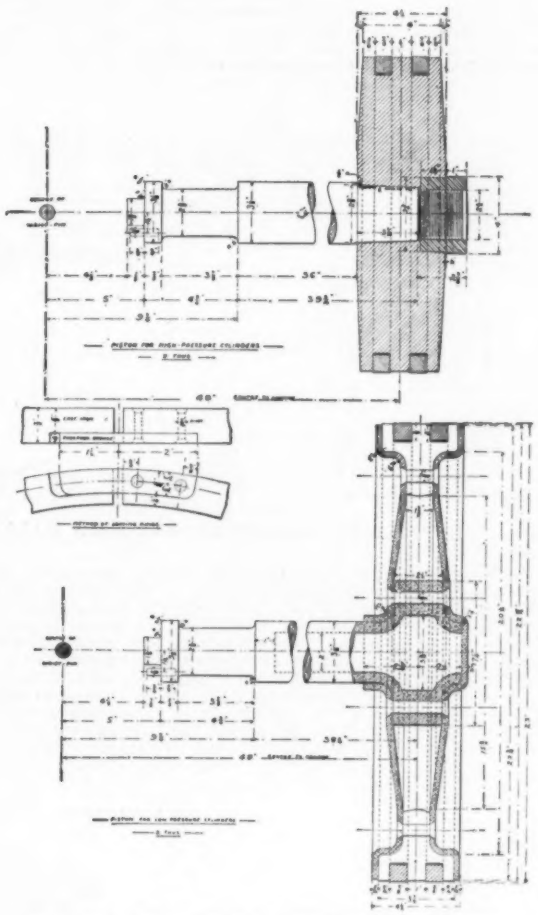
The maximum grades were 60 to 90 feet per mile, from Susquehanna westward, and one of 54 feet per mile for 13 miles, from Port Jervis eastward.

The good results obtained with the special boiler and valve gear of the A. G. Darwin have led the designer, Mr. George S. Strong, to turn his attention to the one

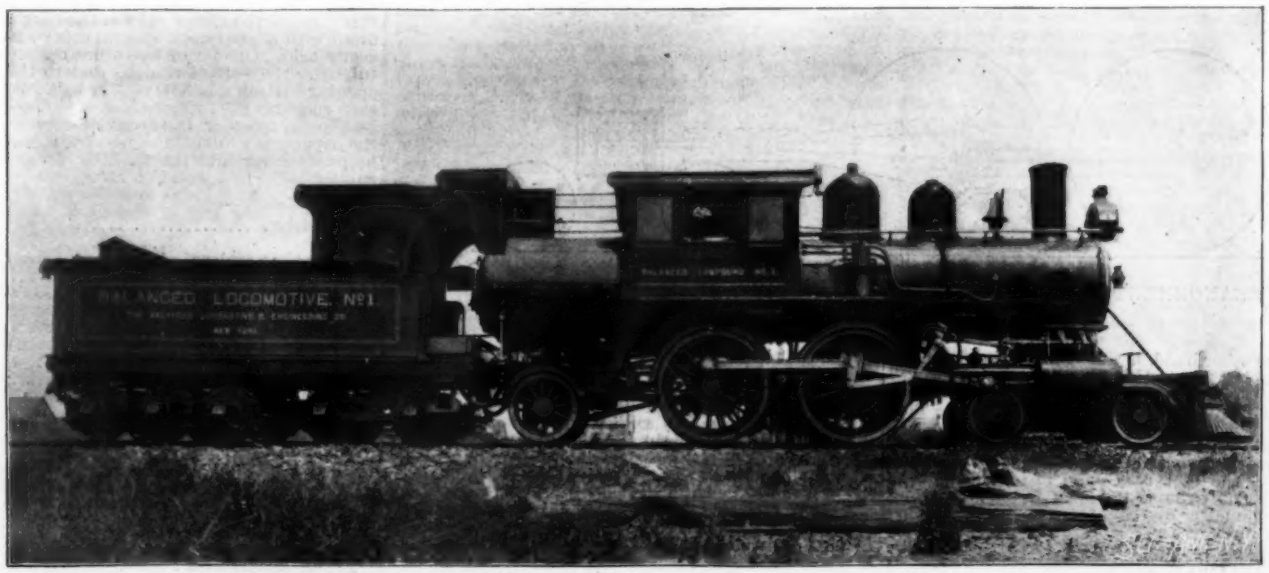


SECTION THROUGH CENTER OF TRUCK AND FRONT INLET VALVE OF CYLINDER. FRONT END ELEVATION.

TRANSVERSE SECTION OF ENGINE SHOWING STEAM VALVE.



DETAILS OF PISTONS—STRONG'S BALANCED LOCOMOTIVE.



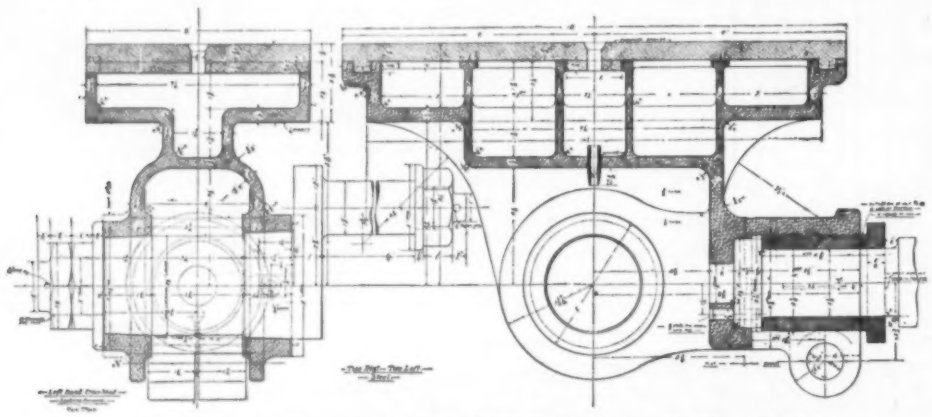
THE STRONG BALANCED LOCOMOTIVE, FORMERLY THE A. G. DARWIN.

Two 16 inch high pressure cylinders; two 23 inch low pressure cylinders by 24 inch stroke; 68 inch drivers; heating surface, 1,680 square feet; steam pressure, 170 pounds; weight of engine, 143,300 pounds.

defect which she shared in common with all locomotives. We refer to the difficulties of counterbalancing, which have caused locomotive engineers more trouble than any other problem.

Now, at the risk of telling our readers something that they know already, we will explain that the violent oscillations which occur in a locomotive when it is running at high speed are largely due to the rapid motion of the various parts of its engines. This motion is of two kinds—revolving and reciprocating. The revolving motion occurs in the cranks, coupling rods and (as it is usually reckoned) the rear half of the main rods; the reciprocating motion in the front half of the main rods, the crossheads, piston rods and pistons. Now it is evident that when the heavy coupling rods, crank pins, etc., weighing many hundreds of pounds, are attached to the wheel a foot or so from the center, they will throw it out of balance as it revolves, producing a disturbing moment about the center.

To restore the equilibrium, it is necessary to place some weight in the wheels on the opposite side of the



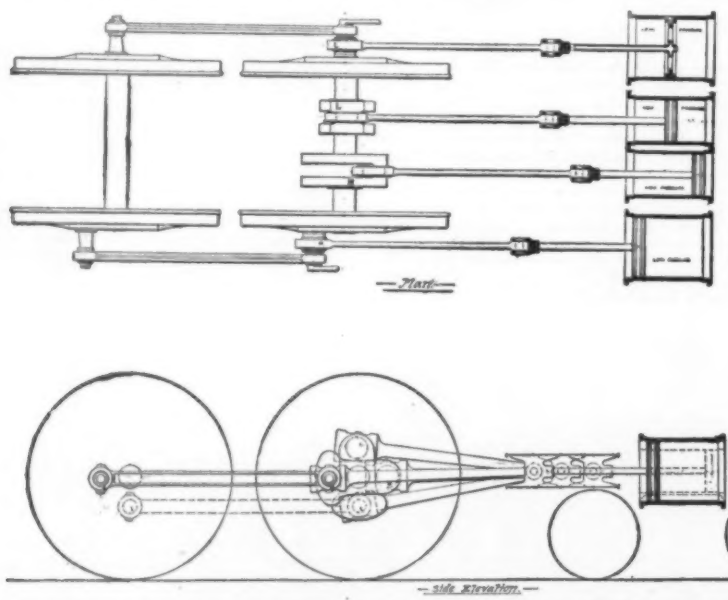
DETAILS OF CROSSHEAD—STRONG'S BALANCED LOCOMOTIVE.

center to the crankpin, and this can be done so accurately that the balance will be practically perfect. So far, so good; but when it comes to balancing the reciprocating, back and forth motion of the pistons, crossheads, etc., a dilemma arises. For while it is possible to counterbalance these parts by placing additional weight in the wheels opposite the crankpins, so that their forward momentum shall be balanced by the backward momentum of the weights, and vice versa, there will be a vertical disturbance of the balance of the wheels which will be exactly equal to the momentum of these added weights. The effect of this "excess balance," as it is called, will be to cause a violent vertical oscillation of the locomotive. On the upward half of the revolution the momentum of the excess weight will tend to lift the wheel, on the downward half to depress it. So powerful is this action that wheels have at times been lifted clear of the track, and the downward momentum has had the dynamic force of a blow, bending the steel rail at every revolution. On the other hand, if the reciprocating counterbalance be left out altogether, the same "hammering" effect is set up in a horizontal direction by the back and forth momentum of the reciprocating parts. This communicates a violent vibration to the whole train, which at high speeds becomes extremely uncomfortable. The locomotive builder is thus placed "between the devil and the deep sea;" and in his dilemma he has taken the only course left open to him, and compromised the matter by counterbalancing only one-half or two-thirds of the reciprocating parts as seems best (or least bad) in his judgment.

Evidently the only satisfactory way to secure perfect counterbalancing is so to arrange the working parts in the locomotive that the revolving parts shall be counterbalanced by revolving parts and the reciprocating parts by reciprocating parts throughout the complete revolutions of the wheels.

The working parts of the A. G. Darwin have been changed so as to meet all the requirements of perfect counterbalancing; and the finished engine is shown in the accompanying illustration. The frame, wheels, boiler, and tender are the same; but here the likeness stops. In place of the former 19 inch cylinders there is a compound engine with four cylinders which are arranged in pairs on either side of each side frame, as shown in the plan view. On the inside of the frames are two 16 inch high pressure cylinders and on the outside are two 23 inch low pressure cylinders. The cranks for the former are turned in the main driving axle, and the low pressure cylinders are connected to outside crank pins in the usual way. The cranks of each pair of high and low pressure cylinders are set at 180°, so that the low pressure crank pin is moving forward when the high pressure crank axle is moving backward, and vice versa. In this way the reciprocating parts of each pair of cylinders are made to counterbalance each other, and a locomotive is produced whose center of gravity is constant, whether she be running or at rest. The pair of cranks on one side are placed at the quarter stroke to those on the other side. In order to make the reciprocating parts of the adjacent pair of high and low pressure cylinders exactly counterbalance, Mr. Strong has designed a special form of low pressure piston and rod. As shown in the drawing, both piston and rod are hollow, the piston being formed of two dished steel plates, the end of the hollow piston rod being flanged out and fitting into shoulders on the inside of the steel plates to which it is riveted. At the periphery the plates are riveted to an annular ring in which the customary grooves are cut for the piston rings. The high pressure piston and rod are made solid and equal in weight to the low pressure piston and rod. The weight of the reciprocating parts is further reduced by using a hollow crosshead of very light design, as shown in the accompanying drawing.

The revolving parts are balanced by placing weights in the wheels in the usual way, except that the counterbalances are placed at the same distance from the center as the crank pin, instead of at the circumference of the wheel. Mr. George S. Strong, the designer,



ARRANGEMENT OF PISTONS, RODS, AND CRANKS—STRONG'S BALANCED LOCOMOTIVE.

tion. On the other hand, if the reciprocating counterbalance be left out altogether, the same "hammering" effect is set up in a horizontal direction by the back and forth momentum of the reciprocating parts. This communicates a violent vibration to the whole train, which at high speeds becomes extremely uncomfortable. The locomotive builder is thus placed "between the devil and the deep sea;" and in his dilemma he has taken the only course left open to him, and compromised the matter by counterbalancing only one-half or two-thirds of the reciprocating parts as seems best (or least bad) in his judgment.

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The revolving parts are balanced by placing weights in the wheels in the usual way, except that the counterbalances are placed at the same distance from the center as the crank pin, instead of at the circumference of the wheel. Mr. George S. Strong, the designer, claims that better results are obtained by this arrangement, inasmuch as the balancing is perfect at all speeds.

Altogether, the balanced locomotive, as it is called, presents many features of design which render it well suited to heavy express service. As the perfection of the balance renders a high piston speed possible, the size of the driving wheels may be reduced, bringing a consequent increase in the tractive power of the locomotive. As an evidence of the smoothness of the running, Mr. J. W. Beach, who superintended the trial trip, states that he was able to read a newspaper as he stood upon the foot plates when the locomotive was running at a speed of 70 miles an hour.

The great hauling power of the locomotive was proved by her pulling out of Colgate Creek siding, on the Baltimore and Spanish Point Railroad, a load of 46 freight cars, 28 of which were loaded, and hauling the same a distance of five miles to Spanish Point. The weight of the train, exclusive of the engine, was 1,365½ tons, and the five miles are on an up grade.

SELECTED FORMULÆ.

Worcestershire Sauce.—There are many concerns, we believe, who make a sauce which they call Worcestershire. That made in England by Lea & Perrin is considered the best, and many have tried to imitate it, but with indifferent success. Of the many formulas which have appeared in print, the following will serve as an example:

Vinegar	1 quart.
Powdered pimento	2 drachms.
" cloves	1 "
" black pepper	1 "
" mustard	2 ounces.
" Jamaica ginger	1 drachm.
Common salt	2 ounces.
Shallots	2 "
Tamarinds	4 "
Sherry wine	1 pint.
Curry powder	1 ounce.
Capsicum	1 drachm.

Mix all together, simmer for one hour and strain.—Registered Pharmacist.

How to Prepare Malted Milk.—The following method is recommended by the editor of Modern Medicine: To a pint of milk add one tablespoonful of malt. The milk may be heated to a temperature of 60° F. After that it should be brought to a boiling point and boiled for twenty or thirty minutes. This will check the further action of the malt. Milk thus treated does not form large, hard curds in the stomach, and agrees perfectly with many persons who cannot digest milk in its ordinary form. This method of peptonizing milk is much preferable to the old way, in which various preparations of pancreatin were employed; these animal substances not unfrequently imparted a very unpleasant flavor and odor, and sometimes poisonous substances. Prepared in the way above described it is always fresh, besides being cheap and convenient.

To Prevent Sea Sickness.—The following is recommended by a physician, as a preparatory treatment, to be begun before the trouble manifests its presence:

Sodium bromide	4 drachms.
Ammonium bromide	2 "
Peppermint water	3 ounces.

A teaspoonful before meals and at bed time. Begin treatment three days before going on board. When preparatory treatment has been neglected and the difficulty fully established, put a teaspoonful in half a tumblerful of water, add a drop of fluid extract of ipecac, and give a teaspoonful every five minutes. It is said to generally relieve in less than half an hour.

Another doctor recommends the following:

Oxalate of cerium	2 grains.
Tincture valerian, ammoniated	1 drachm.
Water	1 ounce.

Take at one dose.—Registered Pharmacist.

Chewing Gum.—Chicle, the dried milky sap of the sapodilla tree, is the basis of the best chewing gums. The following is an accepted formula:

Chicle	3½ pounds.
Paraffin wax	1 "
Tolu balsam	[illegible] ces.
Peru balsam	1 "

Soften the chicle by working it in hot water. A portion of the water is taken up. To the softened chicle add the paraffin previously melted and mix all together. Then prepare the following:

Sugar	10 pounds.
Glucose	4 "
Water	5 pints.

To the water contained in a suitable vessel add the sugar and glucose, dissolve and boil. This forms the sweet constituent of the chewing gum, and flavoring and color should be added to suit the taste. The candy compound is poured out on an oiled slab and sufficient of the chicle compound, previously described, is added to make the mass tough and plastic.—American Druggist.

A Simple Method for Preparing Oxygen for Inhalation.—In a three-necked flask, with capacity of from 2 to 4 pints, introduce from 100 to 200 grammes [3 to 6 ounces] of manganese peroxide, and an equal quantity of barium peroxide, and add sufficient water to cover the whole. To avoid foaming, add a thin layer of oil to this. Fit to the center neck of the flask a glass funnel fitted with a stop cock and fill this with concentrated acetic acid. On one of the other openings fasten the tube for the exit of the gas and to the other of the openings attach a hollow rubber ball. By opening the stop cock on the funnel a few c. cm. of the acid may be allowed to enter in successive portions, and in case the oxygen is evolved too rapidly, it can be retarded by pressing air into the flask by compression of the rubber ball.—Brit. and Col. Druggist.

Liquid Sauce.—

Vinegar	40 fl. oz.
Sherry	20 oz.
Freshly powdered allspice	2 drm.
Freshly powdered cloves	1 "
Freshly powdered black pepper	1 "
Freshly powdered ginger	2 "
Freshly powdered capsicum	1 "
Freshly powdered mustard	2 oz.
Salt	2 "
Molasses	10 "
Shallots, bruised	8 "
Tamarinds	6 "
Curry powder	1 "
Lemon, sliced and bruised	1 "

Crush up the whole spices just before use and digest in the vinegar on the water bath for one hour in a covered vessel. When cool, add the sherry and molasses, and let stand for a week in a well-corked jar, then strain and bottle off.—Brit. and Col. Druggist.

Liquid Rennet from Pepsin.—

Pepsin in scales	1 dr.
Wine	1 fl. oz.
Glycerine	½ "
Water, to make	4 "
Hydrochloric acid	15 drops.

Mix. —Montreal Pharmaceutical Journal.

ENGINEERING NOTES.

St. Petersburg is now connected by rail with the Yenisei River, and it is expected that the Trans-Siberian Railroad will reach Lake Baikal next summer. China's concession that the road may pass through Manchuria shortens the distance from the lake to Vladivostok by over 600 miles.

The Swiam tunnel, on the Transcaucasian Railway, is located at an altitude of 1,120 meters (3,674 feet) and is 3,963 meters (2·4 miles) long. It has been completed in four years. The average advance in 24 hours was about 5½ meters, which is a record in the construction of long tunnels.—Uhland's Wochenschrift.

The Chinese government have given permission for construction of the main line of the Siberian Railway through Northern Manchuria to Vladivostok. By virtue of the new agreement the route will be greatly shortened, as the line, instead of skirting the banks of the Amur, will cross that river into Chinese territory and follow a direct line to Vladivostok.

A serious accident happened to a petroleum motor car a short time ago in the environs of Boulogne. The automobile was traveling down a steep hill at great speed when the driver, to check the pace, put on the brake too abruptly, with the result that the carriage was nearly upset and the two occupants were thrown into the ditch. They were picked up unconscious and were found to be severely hurt.

By a decision of the Prefect of the Seine, horseless carriages have just been admitted to all the rights and privileges for public service of the ordinary fiacre. The step is a wise one, and it will be interesting to watch the progress of the competition. If some such by-law were made in a few large towns in England, the industry might soon become a great one, but all the while it is confined to Crystal Palace exhibitions it is not calculated to make the fortunes of many people.

Among the latest novelties in the machine shop is a hydraulic tool for removing the heads of steel and iron rivets, and intended to supersede the present system of cutting them off by hammer and chisel. The new tool is of the portable type, 18 inches long, and is operated by means of hydraulic power. The hydraulic pump is controlled by a small hand lever and drives a chisel shaped cutter of chilled steel against the rivet head, shearing it off flush with the surface of the plate. The cutter can be readily removed for sharpening.—Boston Journal of Commerce.

A curious defect has been discovered in Buda-Pesth's underground railway. There are not enough ventilating apertures in the tunnel, and the trains rushing through it compress the air in it like that in the tube of a Zalinski pneumatic gun. On some occasions the cars have been lifted from the track and the passengers have been almost suffocated. One stretch of tunnel two miles long has only a single ventilating aperture, making it almost an airtight compartment. Any constructing engineer ought to have known what would be the result of such pneumatic conditions.

The Calais (France) electric lighting station is being run by two 80 horse Niel gas engines, with two cylinders each, says the Progressive Age. They work so well that a 90 horse load can be suddenly taken off each without the engine running away; and the engineer has been ingenious enough to make the engines practically self-starting, by getttng one piston to stop in the position of compression, the other in that of explosion. Both cylinders are filled with a gas mixture which he makes; then the explosion in one cylinder gives rise to compression of gas in the other and causes ignition at the tube, so that the cycle of operations begins.

There is only one railway open for traffic in Siam—the short passenger line connecting Bangkok with Paknan at the mouth of the river. The line under construction from Bangkok to Korat is proceeding toward completion rather slowly, owing to disputes between the Siamese government and the British contractor, but the whole matter is about to be referred to arbitration. The permanent way is laid to within eighty miles of Bangkok, except for a short interval at Ayuthin. The necessity for a northerly line to Chiengmai is becoming increasingly felt, but until the disputes regarding the Korat line have been settled no decision as to railway extension is likely to be reached.

A tunnel two miles long is being driven for the Metropolitan Water Works, of Boston, Mass. The tunnel is 11⅛ feet by 13½ feet, with four shafts and a portal. No. 1 shaft is 46 feet; No. 2 shaft is 118 feet; No. 3 shaft is 111 feet; No. 4 shaft is 58 feet deep. The entire work—drilling, pumping and hoisting—is being done with compressed air as the motive power. The air is furnished from a plant placed between the portal and shaft No. 4, and is carried about half the distance through an 8 in. pipe, which is reduced to 6 in., and afterward to 4 in. The plant, having two duplex Corliss engine compressors, comprises steam and air cylinders 20 in. in diameter by 36 in. stroke, built by the Rand Drill Company.

The most noteworthy feature in connection with the new Prussian State Railway, which is now in course of construction between the industrial centers of Remscheid and Solingen, will be the viaduct spanning the Wupperthal at the little town of Müngsten, says the Engineer. When completed, the structure will enjoy the distinction of being the loftiest of its kind on the European Continent, eclipsing, both in height and width of its main arch, the celebrated Douro bridge at Oporto. It will, moreover, prove the costliest piece of work hitherto undertaken by the Prussian State Railway Department. The total height of the Douro bridge is 62 meters, or about 204 feet, whereas the viaduct at Müngsten will attain an altitude of 107 meters or about 353 feet. As regards the span of the center arch, the one at Douro measures 160 meters, while that at Müngsten will be 170 meters. Upward of 1,700 tons of ironwork will be required for the principal arch, and the total quantity of iron employed on the viaduct generally will amount to 4,000 tons. Six colossal side pillars will form a support for the remaining portion of the bridge. The cost of the viaduct is estimated at 2,500,000 marks, or $625,000.

ELECTRICAL NOTES.

Lightning struck a football team as it was about to play a match at Liverpool recently, killing one man and badly injuring two others.

The longest commercial distance at which the long distance telephone is now operated is from Boston to St. Louis, a distance of 1,400 miles. This line is more than twice as long as any European telephone line.

Paris policemen have been supplied with electric dark lanterns, by means of which they can see 150 feet away. They were employed successfully in a recent raid in the Bois de Boulogne on the homeless persons who sleep there at night.

An electric railroad has been opened to traffic in Cairo (Egypt) on September 1. The water for feeding the boilers in the power house is taken directly from the Nile. The line is about thirteen miles long and penetrates into the old part of the city.—Uhland's Wochenschrift.

Two new blast furnaces which are at present in course of erection near Stettin, in Germany, are not only to be lighted by electricity, but all the machinery and apparatus connected with the furnaces are to be operated by means of electro motors, the contract for the supply and erection of which has just been placed with Messrs. Schuckert & Company, of Nuremberg.

In Tokio electric tramways are only to be permitted as a municipal concern, and progress has been retarded by a recent refusal of the city council to allow the utilization of the headwaters of the Tamagawa for the generation of the necessary motive power on the plea that the town water supply, which is drawn from a lower reach of that river, might suffer contamination.

It has been suggested, says Electricity, that economy of operation of street railroads would be subserved by placing the wheels on ball bearings, and experiment has shown that the starting torque required on a car so equipped is very much less than on other cars. It seems to be only a question whether the cost of introduction and maintenance of ball bearings is not greater than the cost of the energy that would be saved by their use. If it is not, we may look for far greater station economy in the near future.

The French Thomson-Houston Company is about to commence the installation works of the electric tramways for the town of Alger. The generating works will be erected at the Pâté de Mustapha, and the machinery, in three groups, will have a capacity of 350 horse power. The energy will be furnished by three dynamos of 200 kilowatts each. The carriages will be supplied with two motors, one for each axle, and will accommodate forty-two passengers. They will be lighted with five lamps of 16 candle power. The whole line is to be lighted by electricity at night.

At least one large firm manufacturing dynamos and motors is, says the American Engineer, at work upon a motor that will run at a speed of 10,000 revolutions per minute. This motor, if it can be successfully constructed, will be used by the United States government on men-of-war to start the propelling machinery of Howell torpedoes just before they are fired from their tubes. This torpedo is propelled by the energy stored in a small flywheel inside of it, made to revolve at a speed of 10,000 revolutions, and at present a steam turbine is the only motor of simple form that is available to rotate the flywheel at that speed.

Excessive speed of electric cars is causing trouble at Hartford, Conn., and the Hartford Street Railway Company has been notified of the following results of an investigation made by Mr. A. W. Gilbert, city electrician:

	No. of Readings.	Per cent. of total No.
Under 8 miles per hour	5	3·0
8 to 10 " " "	14	8·6
10 to 12 " " "	47	29·0
12 to 14 " " "	35	21·6
14 to 16 " " "	36	22·2
16 to 20 " " "	17	10·5
Over 20 " " "	8	4·9

A Gloucester exchange says: A novel device looking to the capture of mackerel has been prepared, and will straightway be tried. Capt. Jonathan Chase, of the steamer Peter B. Bradley, of Provincetown, is the originator and leader in using the contrivance, which is nothing less than an electrical engine designed to allure the mackerel to a certain spot, when their capture is almost certain of accomplishment. The boat is equipped with a dynamo, to which are attached long wires from which depend from one to six incandescent light bulbs. These wires can be let down to a depth of 1,200 feet if necessary, or to a depth but little below the surface. The current let on, the lights illuminate the depths, and should the mackerel gather, as it is believed they will, the seine will at once be set around the school. The Bradley is equipped with the necessary apparatus and has an electrician on board. This latest contrivance may revolutionize the mackerel fishery, says the Fishing Gazette.

Electric switching of cars on the Brooklyn Bridge cable railway will soon be in operation. The 20 motor cars built by the Pullman Palace Car Company are now being delivered, and are being fitted with the General Electric Company's motors and equipment. The cars and the system of operation were fully described in our issue of February 26, 1896, but since then the plans have been somewhat changed. The current will not be taken from an overhead wire, but from a third rail, for which purpose each truck will have on each side a collecting shoe, mounted between the axle boxes. The cars are of the usual type employed on the bridge, each having two four-wheel trucks, and each motor car will have four 50 horse power motors. There are two circuit breakers and a magnetic fuse box, 12 resistances and a magnetic blow-out. The motor car of each train will do the switching at each terminal, and will be able to propel the train load of 120 tons over the bridge (on emergency) at the same speed as the cable, 11·3 miles per hour, and to ascend the grades of 3·78 per cent., which are 1,000 feet long. The trucks for the new cars were made by the McGuire Manufacturing Company.

MISCELLANEOUS NOTES.

Within the last decade the population of Europe has increased about 30,000,000, of whom Russia contributed 12,510,000 and France only 67,000.

Balloon experiments were made recently by the Austrian government to test whether serviceable observations could be made at a safe distance from the enemy's fire. A balloon 33 feet in horizontal and 46 feet in vertical diameter was sent up from a point 5,500 yards away from a battery and was kept at a height of 2,600 feet. Eighty shells, containing over 10,000 bullets, were fired at it, but only three small holes, which did not affect its working, were found when the balloon came down. The inference is drawn that in actual warfare balloons can be used to advantage at that distance.

The creation of a new order of knighthood—the Royal Victorian Order—is announced in the London Gazette. It will be conferred upon those among Her Majesty's subjects, or the subjects of foreign states, whose services to herself she desires to recognize by a high distinction. The new order approaches more nearly to the family orders of foreign monarchies than to any order at present existing in the empire. In the first class, which will be very much restricted, the royal princes will be included, but very few others in that country. The order will rank next after the Order of the Indian Empire.

It was shown by M. H. Moissan, about three years ago, that when iron was saturated at 3,000° C. with carbon, and then cooled under a high pressure, a portion of the carbon separated out in the form of diamonds. It occurred to M. Rossel, Comptes Rendus, July 13, that the conditions under which very hard steels are now made should also result in the formation of diamonds; and an examination of a large number of samples of such steel has shown that this is really the case. The diamonds are obtained by dissolving the metal in acid and then subjecting the residue to the action of concentrated nitric acid, fused potassium chlorate, hydrofluoric and sulphuric acid successively. The crystals are very minute—about 15 $\mu\mu$—the largest attaining only 0·5 mm. in diameter, but Nature says they present all the chemical and physical properties of true diamonds.

The United States consul at Catania reports that the Sicilian sulphur industry is in a deplorable state, owing to overproduction and low prices. The consul does not see how production can be reduced; for the mines must be worked, if only to keep out the water, which accumulates rapidly and would soon ruin them. The proposition which appears to be favored by the government is the establishment of warehouses where certificates should be issued for the sulphur deposited, which certificates might be discounted by the banks. In addition, a reduction of the export duty, now $2.25 per ton, is asked. The price of "best thirds" has fallen from 120 lire per ton, in 1876, to 55 lire, in 1895. The wages of the miners have fallen to seven to eight and at most ten cents per day. The report of great sulphur deposits having been found in Louisiana has naturally added to the depression.

The value of the exports of silk piece goods from Switzerland, including neck wrappers and shawls, in 1895 amounted to 86,750,000 francs, as compared with 77,500,000 francs in 1894, an increase of 9,250,000 francs. The exports to France increased from 8,000,000 to nearly 10,000,000 of francs, but it is believed that this export will not reach more than the half of what it was before the establishment of the French custom tariff of 1892. A duty of 200 francs per 100 kilogrammes on black silk goods is regarded as absolutely prohibitive. The United Kingdom is always the largest purchaser of Swiss silks—33,200,000 francs against 29,840,000 francs in 1894. The United States bought to the value of 20,250,000 francs against 17,153,000 in 1894, and Germany to the value of 8,646,000 as compared with 6,563,000. A falling off is shown in the case of Austria-Hungary, Belgium and Turkey, and some other less important countries.

Warm feet during the wet weather are the best preventive against so-called "colds" and their often dangerous consequences. Rubber shoes and cork soles have been generally used to avoid getting cold and wet feet, but a new and very curious means to warm the feet has recently been patented by Paul Wonneberger, of Gruma, near Dresden. He calls his invention "Heatable Shoes." Within the heal of the shoe, which is hollowed out, there is a receptacle for a glowing substance, similar to that used in the Japanese hand warmers. Between the soles, embedded in asbestos covers, there is a rubber bag which is filled with water. The water is heated above the heel, and as it circulates while the wearer of the shoe is walking, it keeps the entire nether surface of the foot warm. A small safety valve is provided, that the bag cannot burst. The warmth given by this sole never rises above 70° F., and will last for about eight hours. The shoes are little heavier than ordinary ones and the sole is but slightly thicker than that of the so-called wet weather boot.

An Italian sea captain is said to have made the extraordinary discovery that a ship goes faster when her sails are perforated with a number of holes than when they are quite sound, says the Steamship. His theory was that the force of the wind cannot fairly take effect on an inflated sail because of the cushion of immovable air that fills up the hollow. To prevent this cushion collecting, he bored a number of holes in the sail, which let part of the wind blow right through, and allowed the remainder to strike directly against the canvas and exercise its full effect. Several trials have been made, and the results are so remarkable that it looks as if this is another of those paradoxical truths which appear so impossible on the surface. The experiments were made in all weathers. In a light wind a boat with ordinary sails made 4 knots, while with perforated sails she covered 5¼ knots; in a fresh breeze she did 7 knots with ordinary sails, and 8¾ knots with Captain Vasallo's invention; in a strong wind she did 8 knots and 10 knots respectively. If this increased speed were sustained throughout a long voyage, it would increase the value of the ship one-fifth, as she would make the same trip in four weeks that she did before in five weeks.

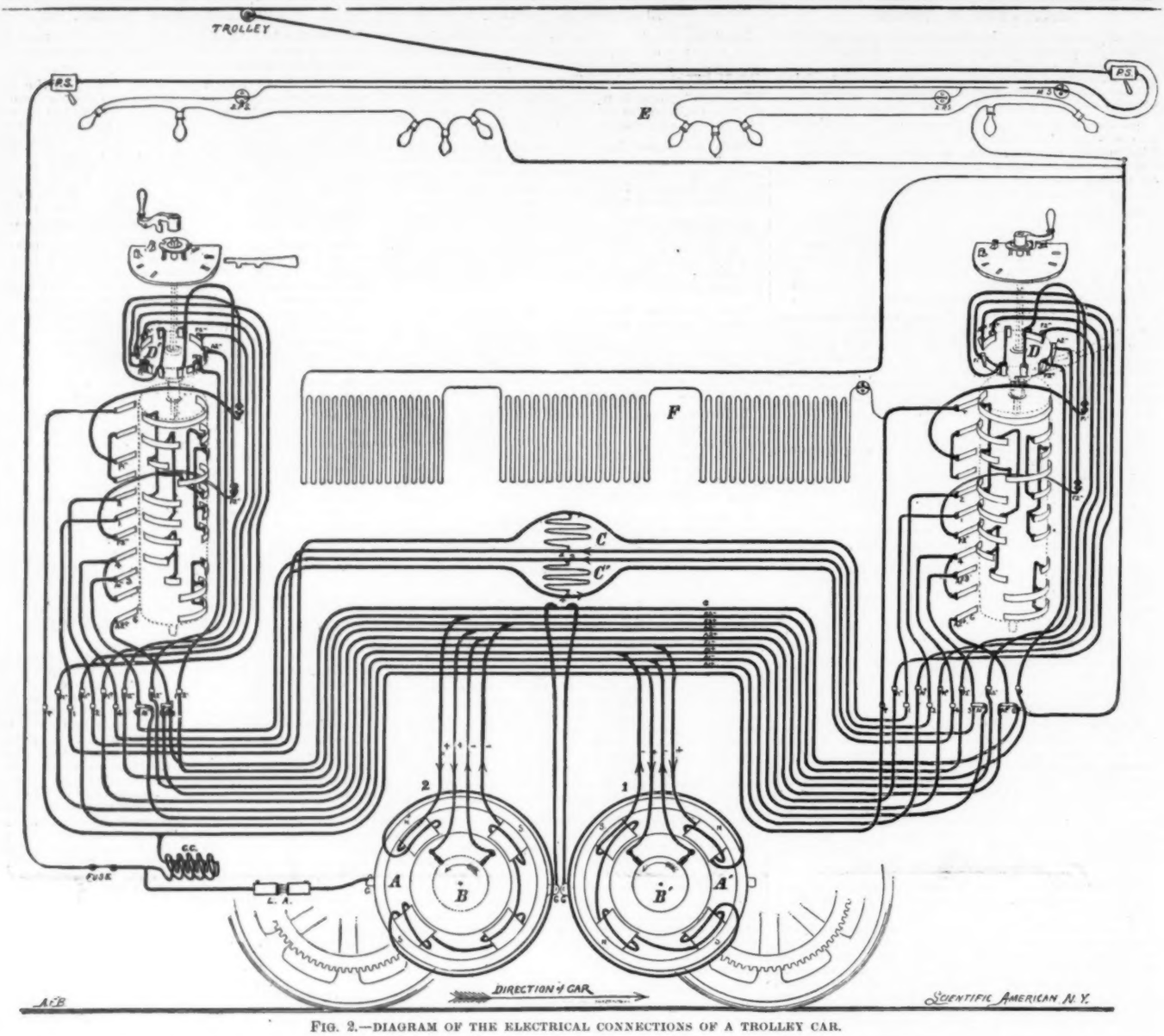
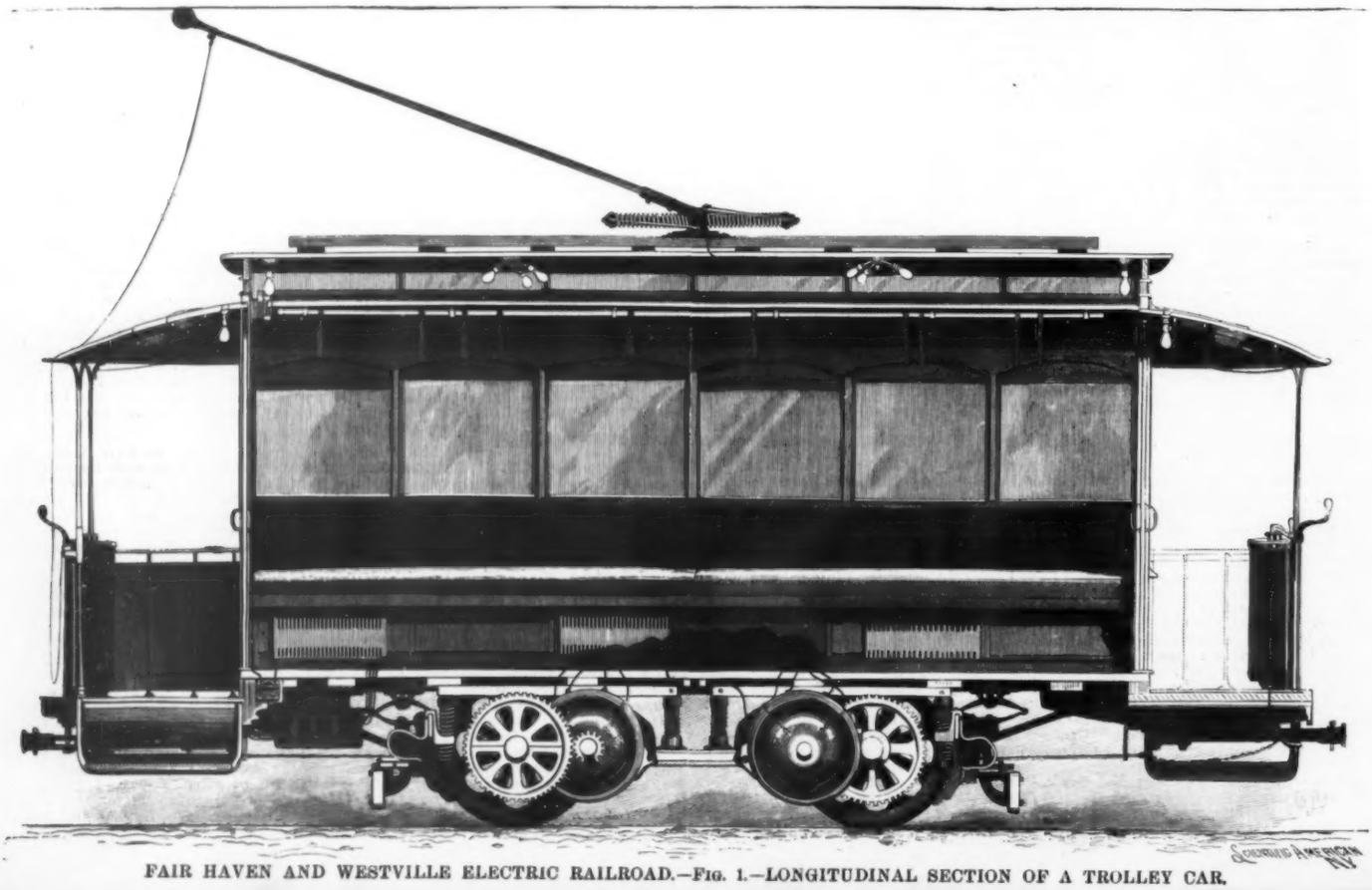


FIG. 2.—DIAGRAM OF THE ELECTRICAL CONNECTIONS OF A TROLLEY CAR.

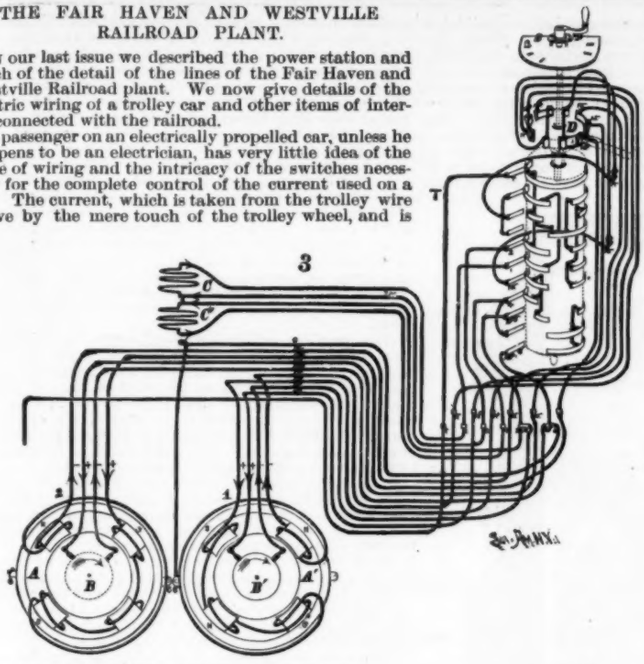


FAIR HAVEN AND WESTVILLE ELECTRIC RAILROAD.—FIG. 1.—LONGITUDINAL SECTION OF A TROLLEY CAR.

THE FAIR HAVEN AND WESTVILLE RAILROAD PLANT.

IN our last issue we described the power station and much of the detail of the lines of the Fair Haven and Westville Railroad plant. We now give details of the electric wiring of a trolley car and other items of interest connected with the railroad.

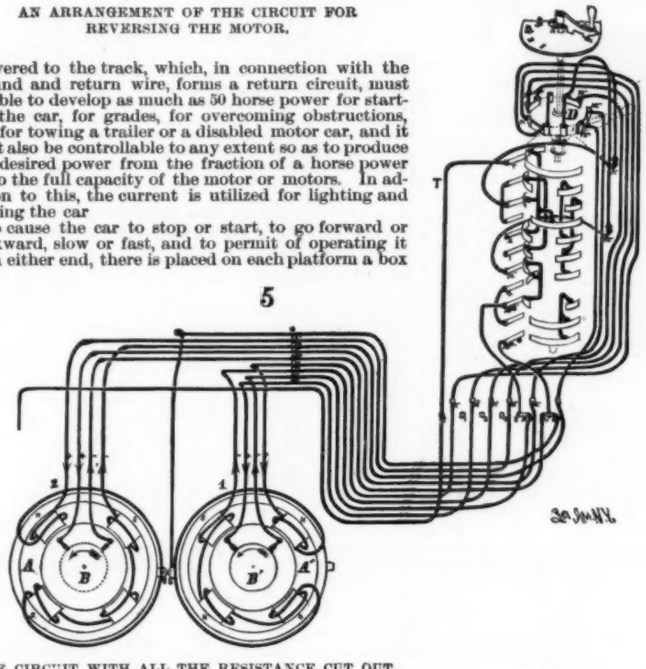
A passenger on an electrically propelled car, unless he happens to be an electrician, has very little idea of the maze of wiring and the intricacy of the switches necessary for the complete control of the current used on a car. The current, which is taken from the trolley wire above by the mere touch of the trolley wheel, and is



AN ARRANGEMENT OF THE CIRCUIT FOR REVERSING THE MOTOR.

delivered to the track, which, in connection with the ground and return wire, forms a return circuit, must be able to develop as much as 50 horse power for starting the car, for grades, for overcoming obstructions, and for towing a trailer or a disabled motor car, and it must also be controllable to any extent so as to produce any desired power from the fraction of a horse power up to the full capacity of the motor or motors. In addition to this, the current is utilized for lighting and heating the car

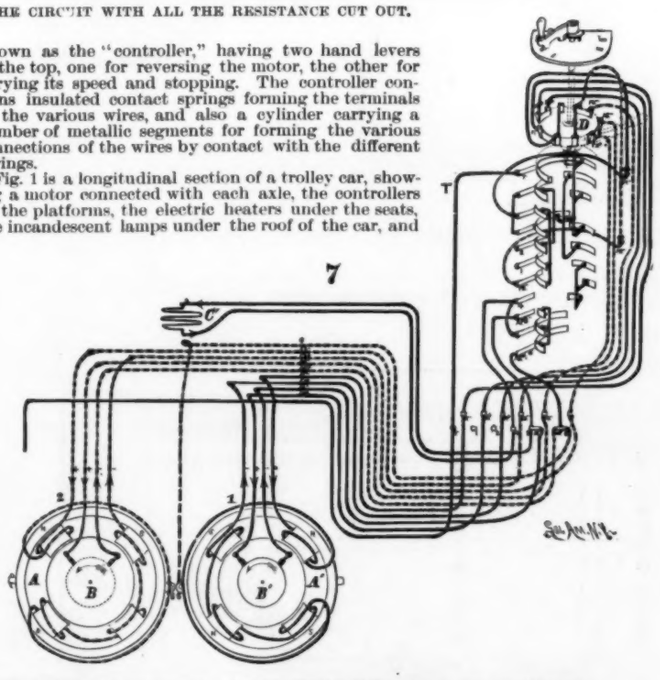
To cause the car to stop or start, to go forward or backward, slow or fast, and to permit of operating it from either end, there is placed on each platform a box



THE CIRCUIT WITH ALL THE RESISTANCE CUT OUT.

known as the "controller," having two hand levers at the top, one for reversing the motor, the other for varying its speed and stopping. The controller contains insulated contact springs forming the terminals of the various wires, and also a cylinder carrying a number of metallic segments for forming the various connections of the wires by contact with the different springs.

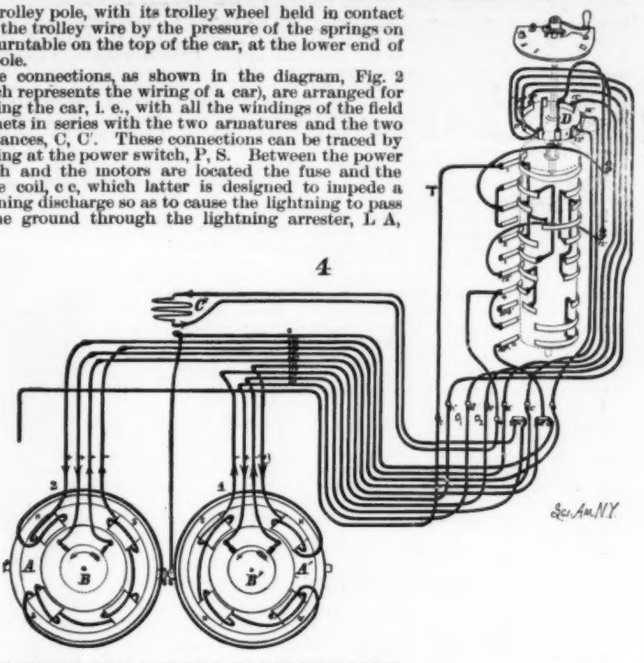
Fig. 1 is a longitudinal section of a trolley car, showing a motor connected with each axle, the controllers on the platforms, the electric heaters under the seats, the incandescent lamps under the roof of the car, and



BOTH MOTORS IN PARALLEL AND IN SERIES WITH HALF THE RESISTANCE.

the trolley pole, with its trolley wheel held in contact with the trolley wire by the pressure of the springs on the turntable on the top of the car, at the lower end of the pole.

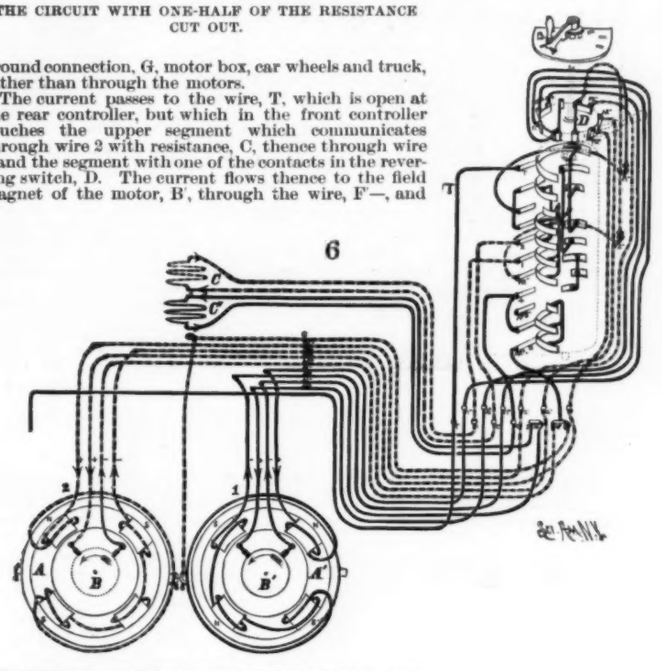
The connections, as shown in the diagram, Fig. 2 (which represents the wiring of a car), are arranged for starting the car, i. e., with all the windings of the field magnets in series with the two armatures and the two resistances, C, C'. These connections can be traced by starting at the power switch, P, S. Between the power switch and the motors are located the fuse and the choke coil, c c, which latter is designed to impede a lightning discharge so as to cause the lightning to pass to the ground through the lightning arrester, L A,



THE CIRCUIT WITH ONE-HALF OF THE RESISTANCE CUT OUT.

ground connection, G, motor box, car wheels and truck, rather than through the motors.

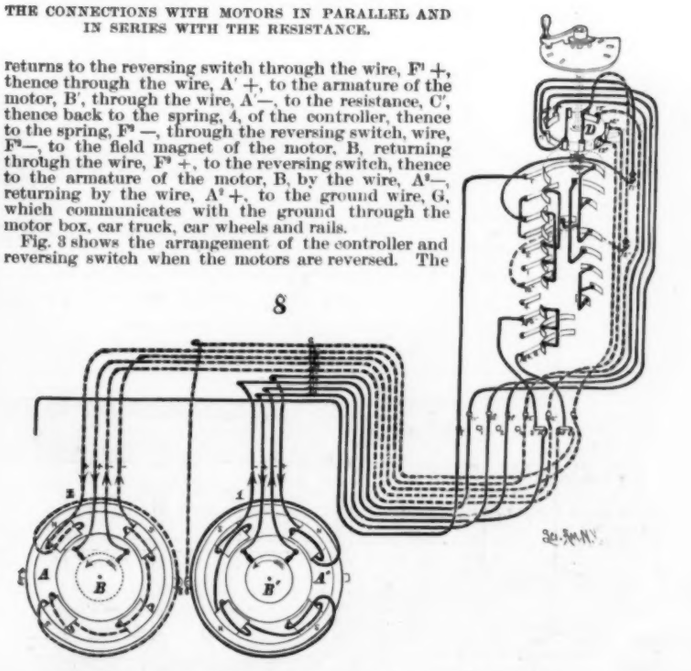
The current passes to the wire, T, which is open at the rear controller, but which in the front controller touches the upper segment which communicates through wire 2 with resistance, C, thence through wire I and the segment with one of the contacts in the reversing switch, D. The current flows thence to the field magnet of the motor, B', through the wire, F'—, and



THE CONNECTIONS WITH MOTORS IN PARALLEL AND IN SERIES WITH THE RESISTANCE.

returns to the reversing switch through the wire, F^1 +, thence through the wire, A' +, to the armature of the motor, B', through the wire, A'—, to the resistance, C', thence back to the spring, 4, of the controller, thence to the spring, F^2 —, through the reversing switch, wire, F^2—, to the field magnet of the motor, B, returning through the wire, F^2 +, to the reversing switch, thence to the armature of the motor, B, by the wire, A^2—, returning by the wire, A^2 +, to the ground wire, G, which communicates with the ground through the motor box, car truck, car wheels and rails.

Fig. 3 shows the arrangement of the controller and reversing switch when the motors are reversed. The



MOTORS IN PARALLEL WITH ALL THE RESISTANCE CUT OUT.

FAIR HAVEN AND WESTVILLE ELECTRIC RAILROAD.

current enters the trolley connection, T, as before, passing to spring, 2, thence to the resistance, C, spring, 1, to the wire, F'—, thence to the reversing switch, D, and wire, F^9 +, to the field magnet of the motor, A'; thence back to the switch, D, thence by the wire, A'+, to the armature, B', of the motor, A', thence to the resistance, C', to spring, 4, through the segment of the controller to spring, F^2—, thence by the wire, F^2—, to the reversing switch, D, thence by the wire, F^3 +, to the field magnet of motor, A, thence to the switch, D, and back to the armature, B, of the motor, A, thence to the ground connection, C.

It will thus be seen that while the current remains the same in the armatures of the motors, it is reversed in the field magnets; this causes the armatures of the motors to revolve in the opposite direction.

When the controller lever is at the first notch the current is fully on, with both the field magnets, armatures and resistances in series, as shown in Fig. 2. When it is at the second notch the resistance, C, is cut out as shown in Fig. 4. With the controller lever at the third notch both resistances, C C', are cut out as in Fig. 5. At the fourth notch the motors are in parallel with each other and in series with the resistance (Fig. 6).

When the controller is arranged as shown in Fig. 7 the two motors are in parallel and in series with half the resistance. When the controller is arranged as in Fig. 8, both motors are in parallel, the resistances being cut out. Circuits shown in dotted lines are in parallel with like circuits shown in full lines.

These various changes in the circuit give all the gradations of power required for starting and for running at different speeds.

The heating apparatus, F, which consists of a series of wire coils arranged under the seats behind gratings, is in parallel with the electric lighting apparatus and the motors. Enough current is taken from the supply wire to maintain a comfortable temperature in the car. There are two lamp circuits on the car, each including five 100 volt lamps, the lamps of each set being in series.

At suitable intervals on the various branches of the road there are telephone boxes, shown in Fig. 9, by means of which the engineer or electrician at the power station can be notified of anything occurring on the lines, and by which the dispatcher is informed whenever an emergency arises calling for more than the usual number of cars.

Much of the perfection of this trolley system is due to the efforts of Mr. Francis G. Daniell, electrical engineer for the company, who has kindly furnished us with the data here presented.

THE PROPOSED NEW YORK UNDERGROUND ROAD.*

ALONG the critical portion of the proposed route, i. e., Elm Street, there was no information at hand showing the kind of material that would be encountered in excavating. I therefore caused to be made a series of borings, similar to those made along Broadway.

The nature of, and the variations in, the soil have been plotted and accompany this report. While the soil underlying Elm Street is very variable in character, more so in fact than was the case in Broadway, it is nevertheless an excellent material in which to conduct such construction as is proposed, being, with but few exceptions, a sharp, silica sand, ranging in quality from what might be termed a good fine sand to coarse sand and gravel mixed, the latter material being found in large quantities. The few exceptions above referred to are streaks or deposits of clay, or clay and sand mixed.

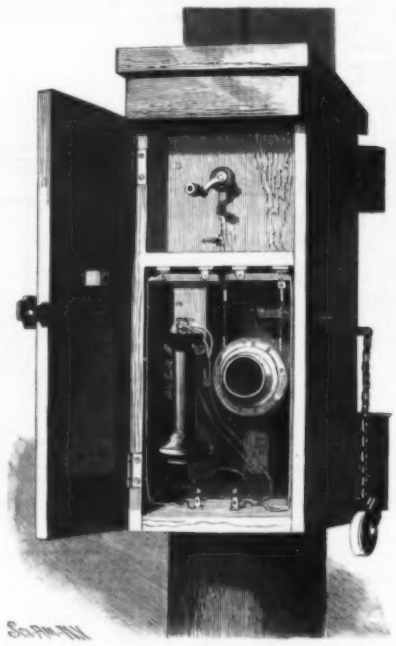


FIG. 9.—TELEPHONE BOX FOR COMMUNICATION WITH THE POWER STATION.

To the depth for which the excavation for the railway will be made, there was no material found which would slide or give difficulty in handling, while much of it is a sand of such excellent building quality that it would pay the contractor to store and use it in the mixing of the mortar and concrete required on the work.

Rock is met with first at Twelfth Street and is found, as a general thing, at or near rail level from there to Thirty-third Street, providing an excellent foundation along Fourth Avenue. Above Thirty-third Street, and on both the east and west side routes, the rock surface undulates greatly and consequently a considerable portion of the excavation will be in that material, but to no greater extent than was anticipated in the original preliminary estimates for the same routes.

No part of the route as herein contemplated is a main thoroughfare for water and gas pipes, or electrical subways, while Elm Street, being at present with no outlet at either end, contains no pipe of large size, and what pipes are there now will all be replaced on the opening and construction of the new street.

At Fifth Avenue and Forty-second Street there occurs the most serious pipe crossing along the route, as the large Croton water main runs down the avenue. Fifth Avenue, however, at that point forms a decided ridge, the surface of Forty-second Street falling rapidly both to the east and west. In order to have suitable gradients for operating a railway, it would be desirable to pass sufficiently below the level of the avenue to leave all the water and gas pipes undisturbed overhead.

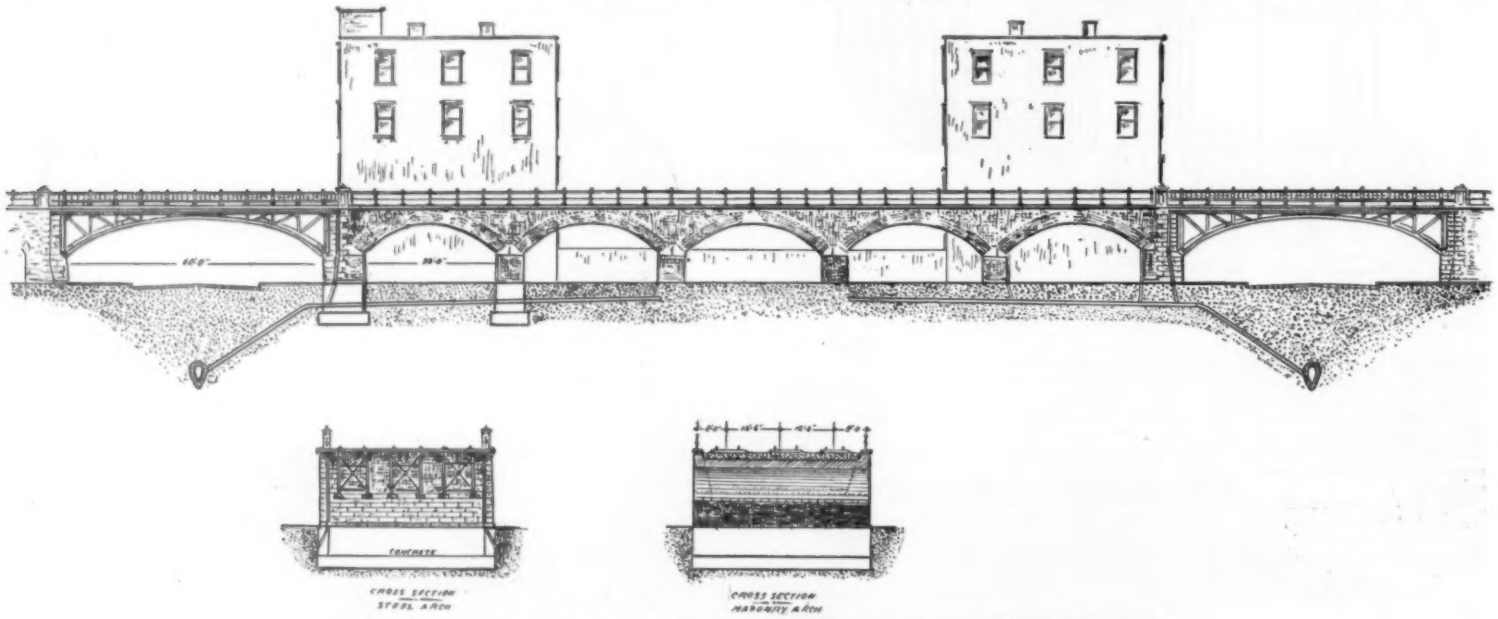
The portions of the proposed route that formed a part of the route previously adopted were recognized as presenting no serious difficulty in construction. The physical investigations and survey of the newly considered portions show that they contain no features that will cause the road to be excessively expensive, slow, or difficult to build, and the proposed route, therefore, escapes entirely the difficulties to construction which were present along Broadway, incident to the heavy traffic, cable railways, complications of sub-surface structures and the care of abutting buildings. The work can be attacked at as many points as can be conveniently operated at once, and the whole brought rapidly to completion at the same time.

With the idea of building only so much of the railway as certainly will be profitable to operate at the outset, One Hundred and Thirty-fifth Street will be a satisfactory temporary stopping place on the west side. The Third Avenue Railway Company has secured a franchise for a cable or electric railway to run over the Boulevard and Kingsbridge Road to Yonkers, and I believe arrangements have been made to commence construction in the spring. With this line in operation, the residents of Washington Heights, Inwood, Kingsbridge and even Yonkers, can be picked up and brought down by the surface line to One Hundred and Thirty-fifth Street, and there take a fast express train for points in the lower part of the city.

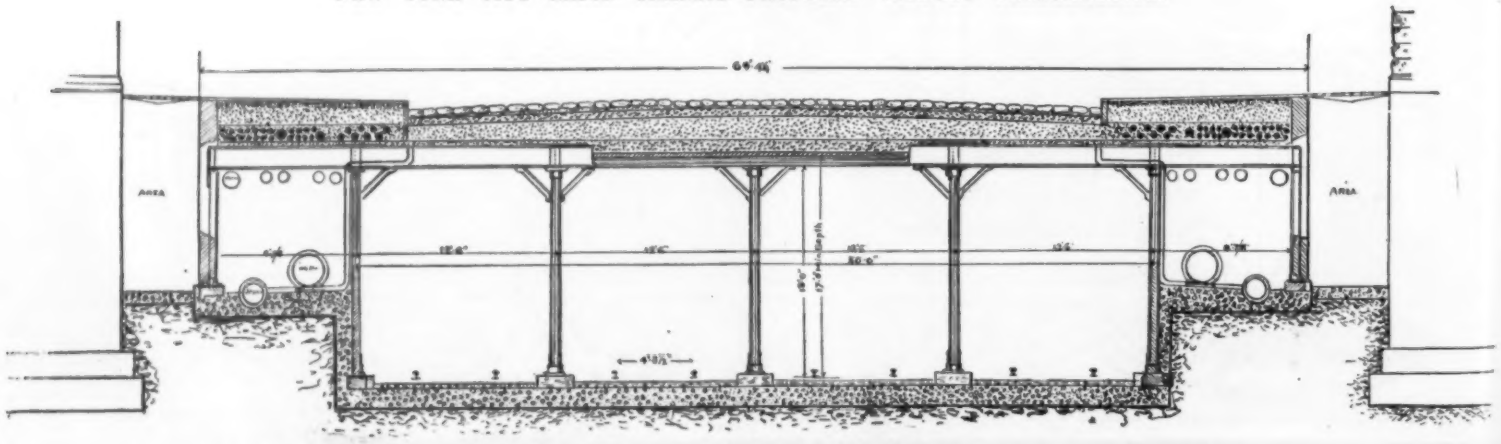
The combination of express trains on the Rapid Transit road below One Hundred and Thirty-fifth Street and the surface service above that point will furnish rapid transit facilities to the upper district vastly superior to those now offered, and will tend to develop that section and to demonstrate at an early date the profitableness of an extension of the Rapid Transit Railroad to One Hundred and Eighty-fifth Street, to Kingsbridge or beyond.

In studying this question, on the east side of the city, I have considered the existence of the elevated railroads, and have deemed that the best results for the city at large and for the parties who will construct and operate the Rapid Transit Railroad will be obtained by building the new railways as far removed as possible from the present lines, leaving the latter free

* Abstract of report presented to the Board of Rapid Transit Railroad Commissioners of the City of New York, by its Chief Engineer, W. Barclay Parsons, November 5, 1896.



NEW YORK CITY RAPID TRANSIT—PROPOSED VIADUCT CONSTRUCTION.



NEW YORK CITY RAPID TRANSIT—CROSS SECTION THROUGH ELM STREET TUNNEL.

to take care of their legitimate traffic, but by improved and extended facilities if necessary. The business of the street railways (including the elevated railways) in this city is increasing at a rate twice and a half as fast as the population. The normal increase in traffic will not only provide a profitable business for the Rapid Transit road without drawing from existing lines, but makes it appear certain, if the past is any guide to the future, that at no very distant date both the existent lines and that proposed in this report will be insufficient to properly care for the travel. I have, therefore, endeavored to study out a location that will allow the new and old systems to be developed from independent territory.

The board of experts under Mr. Hewitt, when considering this question, made a suggestion in regard to the desirability of laying out a line in the neighborhood of Lenox Avenue and north of Central Park. North of One Hundred and Tenth Street, between Eighth and Third Avenues, is a portion of Manhattan Island which now supports a large population, and which is capable of supporting a still larger one, but which is wholly without rapid transit lines. This is the best field in New York City for creating traffic. If, therefore, instead of carrying the new route through and along Fourth Avenue, or to the eastward of it, it should be carried to the westward of Fourth Avenue, it would be removed from the existing railroads, and serve to create its own traffic, and at the same time provide rapid transit facilities for a portion of this city's population which is now removed to an inconvenient distance from the elevated railroads.

latter extension could, therefore, be properly taken up as the line of the proposed Rapid Transit Railroad. It would be a direct northerly extension of the Lenox Avenue line and would secure for itself a large territory free from competing railways.

There are two ways in which a line can be built in this territory. One would be after crossing the river to build an ordinary elevated railroad along Girard Avenue to its intersection with Jerome Avenue, and then an elevated line along Jerome Avenue northward to such point as may seem desirable. The other would be to acquire private property and build a railroad, elevated, depressed, or on an embankment inclosed between retaining walls, as the topography of the land will indicate.

For a distance of about two miles north of the river, this road could be constructed without interfering with the grade of any cross streets, they being carried over or under the railway, as may be found most convenient. The construction of such a road, exclusive of the cost of right of way, would be less than the cost of an ordinary two-track elevated road for the same distance. After passing two miles, however, it will not be so economical to construct the road over private property. The ground rises abruptly, and it would be necessary to have the railway in tunnel for a long distance. The road would, therefore, terminate for the present at Tremont or Burnside Avenues and wait for the traffic to develop.

The Board, in its resolution, determined that four tracks should be constructed to Forty-second Street. On the easterly extension northward from that point, the following schedule, it is believed, could be successfully operated:

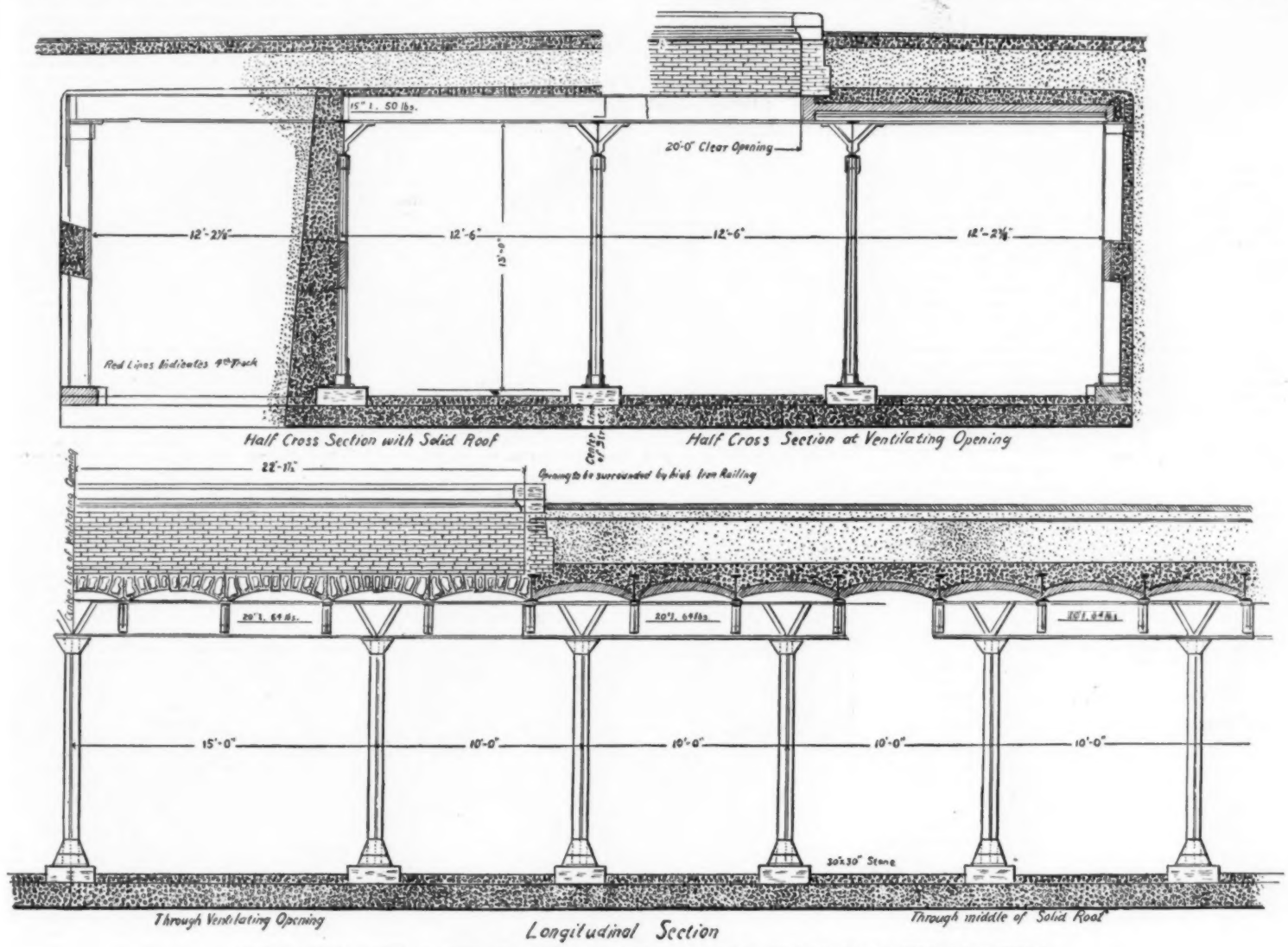
City Hall to Forty-second Street.....	5½ minutes.
" " One Hundred and Twenty-fifth Street.....	21 minutes.
City Hall to North side Harlem River.	24 "
" " Fordham Road via west side.	35 "
" " Sixtieth Street	11 "
" " One Hundred and Thirty-fifth Street....	21 minutes.

If the One Hundred and Twenty-fifth, Ninety-sixth, and Sixtieth Streets stops were omitted, the running time from the upper points would be reduced.

The construction designs have been carried only sufficiently far to form a basis for estimates. For the greater part of the route the construction would naturally be in conformity with the detailed plans previously worked out. Along Elm Street pipe galleries have been designed somewhat similar to those previously drawn for the Broadway route. The number of pipes to be contained in these galleries will not be as great as those that would have been provided for in Broadway, and the Elm Street galleries need not, therefore, be quite so capacious.

Along Lafayette Place and Fourth Avenue, where the street is 100 ft. wide, a plan of construction similar to that previously designed for Fourth Avenue can again be adopted, the pipes resting either directly on the roof of the tunnel, or at the side, between the outer walls and the curb lines.

On the two and three track portions, the drawings



NEW YORK CITY RAPID TRANSIT—BROADWAY AND BOULEVARD CONSTRUCTION.

I have, therefore, made a very careful study of this region. It can be best served by carrying the rapid transit railroad up Fourth Avenue, alongside of the Harlem Railroad to One Hundred and Tenth Street. From that point branching off at or near One Hundred and Tenth Street, passing through the rear of the lots abutting say on One Hundred and Tenth Street, to a point to the east of Lenox Avenue, but sufficiently far to the west of Mount Morris Park to avoid the valuable residential property abutting on that square, thence turning to the right with an easy curve, and running straight to the Harlem River, parallel to Lenox Avenue. The right of way for this purpose from One Hundred and Tenth Street would have to be acquired by purchase. This line prolonged across the Harlem River would reach the Annexed District at about One Hundred and Fiftieth Street.

In the Annexed District it would seem to be wise to leave the district lying east of the Harlem Railroad to be served for the present by the improved facilities which can be afforded by the Manhattan Company. Should the Manhattan Railway Company refuse to extend and improve its service, it is quite possible to lay out and construct a new line into the east portion of the upper wards. The officers of the Manhattan Railway Company stated, however, that if they were compelled to build extensions through the easterly portion of the Twenty-third and Twenty-fourth wards, they would find it a financial burden at the same time to construct lines through Jerome Valley as well. This there is room for but two tracks on the west side of the Harlem Railroad and under or over Park Avenue to One Hundred and Tenth Street. On the line to the westward from One Hundred and Tenth Street to or near Lenox Avenue, I have continued the two-track section, but from One Hundred and Eleventh Street northward to the Harlem River I have estimated on a third track to be used for express trains.

On the west side line, I have estimated for a two-track road through Forty-second Street and up Broadway to Fifty-eighth Street, and a three-track road from there to Ninety-eighth Street. Stations at Sixtieth and Ninety-sixth Streets, at which points the Board had previously laid out express stations, could be arranged in a similar manner to the station at One Hundred and Twenty-fifth Street on the east side line, so that an express could stop at either or both of these stations, or, if desired, could make a continuous run from One Hundred and Third Street station to Fifty-third Street, a distance of 2¼ miles.

As soon as the traffic warrants it, complete four-track roads can be constructed on both the east and west side lines, so as to give a continuous express service, both north and south, at all hours. On Park Avenue north of Forty-second Street the space on the east side of the Harlem Railroad can be used for the additional tracks.

Supposing, however, the trains to stop at One Hundred and Twenty-fifth Street on the east side and at Sixtieth and Ninety-sixth Streets on the west side, themselves indicate how these parts of the railway can be widened into four-track systems at any time without interfering with the traffic, and an extension south from the post office under Broadway, as well as extensions north from the suggested east and west termini, can be made in like manner, which are conditions laid down in the resolution of your board. The only radical change in construction from the previously considered plans is the viaduct portion through the blocks north of One Hundred and Tenth Street. A typical design of this structure is shown on one of the drawings The part of the railway built on private property could be erected on brick arches supported on concrete piers. The streets could be spanned from house line to house line by steel arches, the masonry construction forming suitable and efficient abutments. These arches are designed to give as the minimum of headroom 12 ft. at the curb and 14 ft. at the center of the roadway, which is greater than the minimum clearance of the Manhattan Railway. This arch construction, although costing considerably more than ordinary steel elevated spans, gives a structure that will be very economically maintained, one that will bear the heaviest and most severe traffic, one that will be almost noiseless, and one that will diminish the unsightliness of the railway to the minimum. The design is closely allied to the design of the famous Stadtbahn, in Berlin, which is very properly considered the finest piece of urban railway construction, where the objections to other similar railways in respect to noise and appearance have

been so eliminated that high class and expensive private residences have been built in its immediate neighborhood.

South of the Brooklyn bridge station, at City Hall, a complete loop can be constructed, so that there will be no switching or crossing of express and local trains. As the most convenient location for this loop would be around the post office, the opportunity is afforded to have a station in Broadway at that point. The cable pits of the Third Avenue Railway Company compel the line under Park Row to be depressed, and it will probably be found convenient to have the post office station a few feet lower than the ordinary stations elsewhere, and thus the pipes in Broadway can be left undisturbed overhead. Two tracks have been projected to serve the post office on the Mail Street and Park Row sides, so that direct and constant communication can be had between the post office and Grand Central Station and much time saved over the present system of transfer by vans. Other tracks for the storage of trains or for sidetracking temporarily disabled trains can be provided. Should the newspapers, whose offices are on Printing House Square and Park Row, desire it, it is possible to construct for them a special track, on which, during the night, cars can be set, one or more for each newspaper, and into which the morning editions can be loaded directly from the press rooms through the vaults under the sidewalk. These cars can be taken to the Grand Central Station in five minutes on express trains, and so save on all papers sent north and east over half an hour.

In estimating upon the plans herein proposed, the cost of real estate, as well as construction proper, had to be taken into account, as private property to a large amount will have to be acquired. To ascertain the probable cost of construction, profiles covering all the routes have been prepared, and stations located corresponding to the stations previously decided upon by your board in connection with the Broadway plans.

The actual quantities of the different classifications of material to be excavated, and the value of the material entering into the work, have been carefully computed. Prices have been assigned to the various items after consultation with large contractors and after taking into account the prices used in previous estimates, or as modified by the experience gained in similar work in Boston, or by recent large street excavations made in this city. The quantities taken and the prices allowed are, in my judgment, amply sufficint to complete the work.

The total mileage contemplated by this report is as follows:

Two-track	10·90 miles.
Three-track	3·99 "
Four-track	3·03 "
Total	17·92 "

I believe that the work as described in this report and its accompanying drawings, including proper terminals and storage places, can be constructed and built in the most substantial and approved manner for an actual cash cost of $20,048,000, with an extra allowance of $1,200,000 for interest during construction. Although, in my judgment, the work can be completed for the sum named, I should advise that an extra arbitrary allowance be made to cover extraordinary contingencies, and such extras as human foresight cannot see. To cover all such contingencies, an allowance of 20 per cent. would, in my opinion, be amply sufficient.

In order to estimate the cost of the right of way, I procured the advice of those conversant with real estate values, and, acting under such advice as the best means of proceeding, I ascertained the assessed valuation of all land to be taken.

The actual value of the real estate, determined on the basis as herein described, amounts to $3,000,000 and the cost of the railway complete would, therefore, be as follows:

Construction	$20,048,000
Real estate	3,000,000
Interest	1,200,000
Total	$24,248,000

If to this be added the very ample amount of unforeseen contingencies already suggested, we have as an outside estimate of money which should be in hand for the work the sum of $29,097,600.

WILLIAM BARCLAY PARSONS,
Chief Engineer.

MEASUREMENT OF HIGH TEMPERATURES, ESPECIALLY OF THE MELTING POINTS OF SOME INORGANIC SALTS.—John McCrae (Annalen der Physik und Chemie).—The author makes use of a thermo element of platinum and platinum-rhodium consisting of two wires of 10 cm. long and 0·2 mm. in thickness. These were soldered together in the flame of detonating gas, and were melted to copper wires at their other end. The copper wires lead to a Quincke multiplier. The electromotive power of the element, corresponding to which a current is generated if the point of contact of the platinum and platinum-rhodium wire is heated, and the point of junction with the copper is kept at a constant temperature, is between 300° and 1,400° C. proportional to the temperature.

THE VERDIN SPHYGMOMETROGRAPH.

As well known, the graphic method consists in registering motions upon a movable surface, either with a pen upon white paper or with a style upon paper coated with lampblack, through the intermedium of elastic tubes and drums provided with levers. The great advantage of this method is that it furnishes authentic data that can always be consulted. Its principal drawbacks are the high price of the apparatus, on account of the quantity of clockwork, and the impossibility of comparing the graphic diagrams when the experiment lasts a long time or when the apparatus is changed. It is, nevertheless, possible to remedy this latter inconvenience in a large measure, and the following is quite a recent method that has been proposed to this effect.

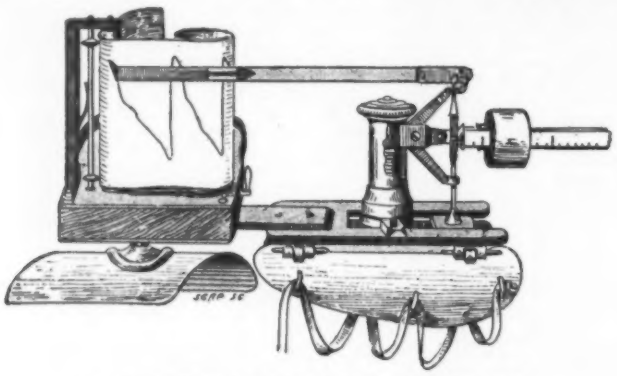


FIG. 1.—VERDIN'S SPHYGMOMETROGRAPH.

The graphic method, which has rendered great services in physiology and the experimental sciences, may prove no less valuable in medicine. It has been profitably employed by Lorrain in the study of fever, and valuable elements of diagnosis are derived from it in various hospitals. For the accurate diagnosis of affections of the heart it is almost indispensable, and will become still more so with the valuable improvements that have been introduced into the classic sphygmograph, that is to say, Philidelphien's apparatus for registering the beatings of the pulse. Thanks to Mr. Charles Verdin, who has gotten up most of the models used in medicine and physiology, we now have an apparatus called the sphygmometrograph, which permits of knowing the exact pressure exerted upon the artery, and which consequently eliminates one of the principal causes of error in the ordinary sphygmographs, with which, according to the pressure exerted, we obtain different graphic diagrams from the same subject. This result is attained through a weight sliding upon a prismatic rod and pressing upon the artery through the intermedium of a small ivory disk. The rod is so graduated as to permit of converting the pressure exerted into centimeters of mercury of the ordinary pressure gage. The variations in volume of the artery for such pressure are, through the intermedium of an inscribing lever, accurately transmitted to a band of paper, three feet in length, wound around a drum.

FIG. 2.—APPLICATION OF THE SPHYGMOMETROGRAPH.

Upon moving the weight back to a certain distance, that is to say, upon increasing the pressure, the artery is flattened, and the inscribing lever then remains immovable. One may, therefore, be sure of thus knowing accurately the weight that balances the arterial pressure—a datum of great importance, thanks to which it is possible to foresee and sometimes prevent cardiac troubles.—Le Monde Illustré.

SOME EFFECTS OF THE X RAYS ON THE HANDS.

By S. J. R., in Nature.

AT the request of the editor of Nature, I append the following description, compiled from notes, of the effect of repeated exposure of the hands to the X rays. The result, though perhaps interesting from a medical and scientific point of view, has been most unpleasant and inconvenient to myself—the patient; and although my theories may be incorrect, and my conclusions easy to demolish, there is no mistaking the fact that the X rays are quite capable of inflicting such injury upon the hands as to render them almost useless for a time, and to leave in doubt their ultimate condition when entirely freed from frequent daily exposure to their influence.

Now for facts. I commenced demonstrating early in May, with a coil capable of giving an 8 inch spark, and have been engaged in the work for several hours per day until the present time. For the first two or three weeks no inconvenience or discomfort was felt, but there shortly appeared on my right hand fingers numerous little blisters of a dark color under the skin. These gradually became very irritating, the skin itself very red and apparently much inflamed. The irritation increased, and the application of aqua plumbi, as recommended in a Berlin telegram to the Standard, had only a passing effect in allaying it. So badly did my hand smart, that I was constantly obliged to bathe it in the coldest water I could get, and I really believe I should have been obliged to resign my appointment had not a well-known medical man, who happened to attend one of the demonstrations, advised me to use a much advertised ointment. I did so, with the remarkable result that the irritation left me immediately, and by using it regularly since then, I have at least avoided one of the disagreeable consequences of too much X rays. In the meantime, however, the skin on the fingers had become very dry and hard, yellow like parchment, and quite insensible to touch, and I was not at all surprised to find, a day or two afterward, that it began to peel off. When this particular unpleasant operation had been accomplished, I considered I was quite acclimated to the rays, but soon found out my mistake. The same symptoms again appeared, the newly formed skin going the same way as in the former case. But there was a further discomfort to follow. About the middle of July the tips of my fingers began to swell considerably, and appeared as if they would burst. The tension of the skin was very great, and to crown all, I noticed for the first time that my nails were beginning to be affected. This was the commencement of a long period of really serious discomfort and pain, which was only partly relieved when, from under the nails, there appeared a somewhat copious and unpleasant-smelling colorless discharge, which continued more or less until the old nails were thrown off. With this discharge the swelling in the finger tips decreased, but as the new and old nails began to separate in the middle, the pain was renewed, and I was unable to bear the slightest pressure upon them. The old nails turned quite black and very hard, and the state of my hands may be imagined when I say that I had to keep the fingers in bandages for more than six weeks. It was only in the middle of August that my left hand became affected by the rays, as until then I had principally used my right hand in the manipulation of the fluorescent screen. I naturally expected to again undergo the same experience, with all its discomforts. I had lost the skin of my right hand for the third time, and there seemed to be no probability of that being the last. Several doctors had seen my hands, and taken much interest in their condition, but no one could suggest a remedy.

At last it occurred to me that all the trouble was being caused by the rays burning out the natural oil of the skin, and that if I could in some way supply the deficiency, it might assist in preventing further ill effects. For that purpose I got some lanoline, the oil obtained, so I am informed, from sheep's wool. This I daily rubbed into my hands, and then incased them in a pair of ordinary kid gloves. These gloves, in the course of time, became saturated with the ointment, and there is no doubt that, although in themselves they were quite transparent to the X rays, and therefore no shield in themselves, the fatty matter did, in a great degree, prevent the drying up of the skin in the manner I have described. I do not mean to say that it is an absolute preventive, but it goes a long way toward that desirable end, because since I first used the lanoline, now some weeks since, my hands have not again peeled, although at the present moment (October 17) there are a few slight symptoms of it.

My view of the effect of the X rays is that, in regard to this matter, it is exactly similar to acute sunburn. The symptoms and effect are the same, only that, in the case of the X rays, you have it in a far more concentrated form—in fact, the very essence of it. But whatever may be the cause, the effect is unquestionable. In my case I have had three new sets of skin on the right hand, and one on the left; four of my finger nails have disappeared on the right, two on the left, and three more are on the point of leaving. For at least six weeks I was unable to use my right hand fingers in any way whatever, and it is only since the nails came off that I have been able to hold a pen. Of course it will be a month or two before my hands resume their natural condition, and it is yet, as I said before, a moot point as to what the end will be.

I could say much more on this subject, but already I fear I have trespassed too much on the editor's space. I have written this with the object of placing upon record "the strange case of an X rays operator," in the hope that it may add something to what is known of the new and mysterious power, and lead others, more experienced in scientific and medical knowledge than myself, to devise an effectual preventive against such results as I have described. Many important questions are opened by this remarkable effect of the rays upon the skin and nails, and it may be that in the near future they may be utilized in cases of skin and other diseases. Who knows?

THE PRODUCTS OF MEXICO.

SIR HENRY DERING has sent to the Foreign Office some practical notes on the cultivation in Mexico of the "yuca," or cassava plant, pineappie, ginger, "chicle," for chewing gum, sarsaparilla, jalap, licorice, canaigre, and ramie, says the London Standard. These, together with the plants dealt with in a previous report, form the principal products which may be profitably cultivated, together or singly, either on a large or small scale by persons possessed of some small capital, and desirous of obtaining satisfactory returns therefrom by investing in land in the republic. The fault generally committed by Mexican planters, says Sir Henry, "is the confining their attention to one kind of cultivation on their land. If several different crops were taken off

alternately, as in a system of rotation, or grown in different parts of the land where soil and climate prove suitable, the planter would find himself in even a better financial position than he generally does now. There is scarcely a spot on any estate, whether large or small, in Mexico that is not capable of giving remunerative returns from some plant or another." In addition to government lands there are innumerable tracts held throughout the country by private individuals, which it is probable could be purchased at comparatively low prices, inasmuch as they can never be utilized by their present owners; and contracts might be made with the government by which immigrants settling on such lands might receive the same exceptional treatment accorded to those settling on government lands.

Sir Henry Dering states that yuca is to the peon in the tropical section of the republic what potatoes are to the poor and working people of Ireland. Yuca is a native of the country, and its rise dates back before the conquest by Hernan Cortes, and it has always formed a great portion of the food of ancient and present Mexicans, especially those living in Vera Cruz, Oaxaca, Chiapas, Tabasco, and Yucatan. The returns of yuca cultivation are immense; the yield of an acre contains more nutritive matter than six times the same area under wheat. The writer planted last January in Atlan, Puebla, two rows 150 feet long, and was told by an old cultivator that there was enough food in that plot to feed more than 100 people for six months. The Toltecs and Aztecs knew how to cultivate the pineapple, and when the Spaniards conquered Mexico they found the fruit in the markets of the towns on their way from Vera Cruz to the great Tenochtitlan. From time immemorial, the pineapple has been cultivated in Amatlan, a town two leagues south of Cordoba, from where the ancient Mexicans used to get their main supply. Now it is grown in tropical Hidalgo, Puebla, Vera Cruz, Tabasco, Chiapas, Oaxaca, Morelos, Guerrero, Michoacan, Colima, Jalisco, and Tepic. Besides the fruit being very delicious and wholesome, Sir Henry Dering says a fine wine and vinegar are made of the juice. The leaf furnishes a fiber of extraordinary strength and fineness, making it even more valuable than the fruit. The fiber is made into ropes, cables, binding twine, thread, mats, bagging, hammocks, and paper.

A pineapple rope three and a half inches thick can support nearly three tons. A textile fabric as fine and beautiful as silk is made of this fiber, too. It is believed that the fine cloth of various colors used by the upper classes among the Aztecs was made of the pineapple fiber. The modern Mexicans do not manufacture it much now, except in the Isthmus, where the Zapotec Indians still make a cloth from it and from wild silk. One cause for its disuse is the slow and wasteful manner in which it is separated. Ginger is found growing wild in various parts of Mexico. The returns from an acre of land vary considerably, but when cultivated under favorable conditions, the crops ought to be 4,000 pounds and upward. A man having a ten acre patch would have an annual income of $5,000 to $7,000. Though for years canaigre has been used by the Mexicans, both for medical and tanning purposes, it has but recently attracted the attention of the outside commercial world as a valuable source of tannic acid. The result of investigations has been to create a great demand for canaigre in the tanning business of European countries, and more recently in the leather making centers of the United States. The only supply now to be obtained of this plant is from the wild growth along the rivers and valleys of Western Texas, New Mexico, and Mexico, and Sir H. Dering says a fear has been felt for some time that with the constantly increasing demand the present sources of supply must become exhausted.

TYPES OF BOLIVIAN INDIANS.

BOLIVIA is, above all, a country of mines, and to our days has come the legendary fame of the Hill of Potosi; notwithstanding, it is not less rich in the variety of its agricultural productions and of its cattle breeding. There are found almost all the animals of Europe, and even the particular species of the American continent.

As to the Bolivian population, approximately a third belongs to the European race; the rest are half breeds (cholos) and natives. Our engraving, taken from a photograph, presents two interesting types. The woolly haired llama (Auchaenia llama) which accompanies them belongs to the cold regions of the high mountains of the Andes, whose ramifications extend through higher Peru, which, since the day of its independence, has taken for its own the name of the great South American liberator, Bolivar.

AMERICAN SKETCHES—TYPES OF BOLIVIAN INDIANS.

From a photograph by Dr. J. Vazquez, in La Ilustracion Sud Americana.

MYSTERY OF AMBERGRIS.

ONE of the most costly articles found in pharmaceutical commerce is ambergris, the present market quotations for the gray variety ranging from four to five dollars per drachm. Although not frequently used by most pharmacists, its history is interesting. Concerning it the following recently appeared in the columns of the Boston Transcript:

Three spermaceti whales were companionably floating about in southern waters one sunshiny day not long ago. Two were fine specimens of the genus Physter; the third, however, though of the same species, was lank and scrawny and lolled listlessly on the blue surface of the Gulf Stream, while its more rotund and sportive comrades slashed about vigorously and sent the limpid waters far above them, to fall in refreshing sprays. It was a mystery why any whale at that season should have presented an ill-fed condition, as the feeding grounds had been unusually well populated by the tentaculated and foul-mouthed cuttlefish, Sepia octopodia, and no whale had need to go a single day with an empty stomach.

Perhaps, if the two well-conditioned animals had been less frolicsome and the third more aroused, they would have been on the alert for defense. As it was, a long, narrow boat, pointed at both ends, bore down unobserved upon them and the whalemen sent with unerring aim their weapons straight into the bulky creatures. The scrawny whale escaped, though it made no motion to get away, but because it was evident there would be but little, if any, oil or spermaceti in the animal and because the capture of the two splendid specimens had been more than was expected. It was left unmolested, still rocking lazily in the sea.

Next day, to the amazement of the whalemen, the animal was seen in almost exactly the same spot, as though inviting death. "Well," called out the captain of the whaling fleet, who had been one of the party the day before, "if you wish to die, you poor, lazy lubber, you shall," and forthwith it, too, was disposed of, the easiest task, the men agreed, that they had had in many a day. But little more than two barrels of oil were found in the emaciated whale. Another and vastly more important discovery was the largest single lot of ambergris ever sold in this country. It was exchanged for a check signed by a well-known drug firm of this city whose figures rounded close on to $60,000. Never had so large a check been seen till then in the little Cape Cod fishing town, where it was divided among the whalemen of the fleet, as each man on a whaler receives a certain percentage of a voyage. The number of pounds found in this whale aggregated over 150, valued at $30 per ounce, the price paid for the best ambergris.

It would seem that the animal had sickened of a malady caused by the unnatural growth, and such was undoubtedly the case, and if its sufferings had not been brought to an end by the whalemen, it would have lingered till the disease itself had finally caused death.

Such profound mystery has surrounded this strange subject, and so many fallacies have been written in regard to it, that some of the encyclopedias have—perhaps wisely—left it untouched, or, if treating it at all, have ventured on but the barest generalities, for trustworthy facts relating to this most interesting and singularly valued product are few and far between.

We need touch but lightly on the history of ambergris, though the delusions that were primitively indulged in are extremely fascinating. In the "Arabian Nights" we are told of eastern beauties whose cheeks were marked with moles like bits of ambergris; and in the story of the sixth voyage of "Sindbad the Sailor" we read in the description of the place where the voyagers were wrecked: "Here is also a fountain of pitch and bitumen, that runs into the sea, which the fishes swallow, and then vomit it up again turned into ambergris!" That antique author, Robert Boyle, considered it to be of vegetable production and similar to yellow amber; and thus it received its name, ambergris (gray), gray amber.

This and even more plausible theories are but indeed fallacies that puzzled savants have set forth when they were at a loss to account for its origin. It is now ascertained beyond a doubt to be generated by the large headed sperm whale and is the result of the diseased state of the animal. The victim of this rare malady may possibly, in extremely rare cases (but of this we are not convinced by actual knowledge), throw off the morbific substance; or finally die of the ailment. The disease is located in the intestinal canal, and some savants suppose it to be caused by a biliary irritation. After a deep study on the subject, several modern scientists have agreed that the disorder is akin to the now fashionable human peril, appendicitis, intensified and prolonged in this great mammal, and that dread ailment that has been understood by the surgeons and medical men of the world.

It is known that the ambergris whale feeds upon the cuttlefish. This creature is armed upon his head with a sharp pointed curved black horn resembling a bird's beak, much like that of a parrot, only the lower mandible is the largest. This is found—as it is too indestructible to be digested—in many specimens of ambergris, and may oftentimes aid in establishing a seated disease. It may be considered, though, to be but the primary cause of irritation, as much of the finest ambergris is entirely free from the tough little horn. Such is the effect in the whale of the magnified—and tremendously magnified—illness which when established in our own comparatively puny organisms causes an instant and fatal collapse unless quickly and heroically attacked by the almost miraculous modern skill of the surgeon's gifted hand. The habits of the great water mammals, however, tend to prolong life, and their resisting power against the insidious destroyer is eloquent of their tenacious hold on existence. When we realize the enormous physical strength of the whale, we wonder less at its combative force. These great sea creatures are not fish, strictly speaking, but the largest of living animals, warm blooded, air breathing, bringing forth their young [usually singly] alive and suckling them for a definite period.

They have a disproportionately large head, the body tapering to a broad tail, which aids the creature in swimming and in bringing it to the surface for respiration, and is formed of neither bone or caudal rays, but is supported on a firm cartilaginous foundation. The eyes are not much larger than those of a cow and of the same mild aspect; they are set far back, owing to the extremely developed face. The external ear is of such minuteness that it will hardly allow the entrance of a knitting needle, and is fashioned thus to prevent the undue access of water. The air that the animal breathes penetrates into the large eustachian tubes through the blowholes or nostrils which open on the top of the head, and are for the purpose of respiration and the expulsion of water, and not for the exercise of smell. The mouth is mammoth in size, and is furnished with plates of whalebone or numerous conical teeth, and together the head forms one-quarter, or perhaps one-third, of the total length of the body. Underneath the skin, which is naked, is the thick coating of fat or blubber, preserving the temperature of the body and reducing its specific gravity, and containing the oil for which these creatures are chiefly pursued.

The length of the sperm whale (male) is from sixty to

seventy-five feet, the female being about half as long, the color is blackish and greenish gray above, whitish beneath and about the eyes. They inhabit southern waters, and when pursued the males especially fight savagely. One can imagine to some extent the enormous extent and prodigious size of the mammal when he may believe without fear of contradiction or ridicule that a goodly sized Jonah might be swallowed with hardly a gulp in the nineteenth century species.

When the whale is finally captured—and please bear in mind that we are speaking of the sperm and ambergris whale alone—it is taken in tow along the ship's side. The cutting process is then begun. The tough outer skin and true skin—of which recent observations prove the blubber is a part—are then cut up and boiled, extreme precaution being taken that the woodwork of the vessel does not ignite in the process. The hot oil is then lowered in a cask to swing and swash in the trail of the ship until it cools. Then it is lowered to the vessel's depths. From 1,200 to 2,000 barrels is considered a bon voyage.

To the conservative whalefisher of New Bedford or Provincetown the discovery of ambergris is as unexpected and as longed for as the sheeny splendor of the pearl that gladdens the pearlfisher or the sparkle of the diamond that sends its radiance straight to the heart of the coal miner. There is that delightful uncertainty, that same shake and throw doubt that allures the speculator to take his chance; though that of the whaleman is much more legitimate business, for with the zeal that characterizes these merchants of the ocean there is coupled the absolute certainty of reduplication according to their efforts.

Almost awestruck are the sailors when the cry of "Ambergris!" is uttered. This is the happy event of the lifetime. The substance is carefully taken from the bowels of the whale and is packed in casks, if it is in fluid form, or in sacks if it is dry enough.

It is then brought, in its nauseatingly odoriferous condition, direct to Boston, where it is appraised by the head of the largest wholesale drug firm in the city. This young man has no enviable task before him in ascertaining the value of the article. He has to examine the fetid mass, which is sometimes in a rank liquid state, sometimes of the consistency of soft putty, and again a chalk-like substance. That which is more like putty usually is to be best relied on for making the best market ambergris, and gradually as it dries—the only curing process it undergoes—the unwholesome dark shade gradually turns to a soft squirrel gray. The substance lightens in weight, and the subtile, fascinating odor develops, an odor almost indescribable, like the blending of new mown hay, the damp woodsy fragrance of fern copse, and the faintest possible perfume of the violet.

And to what use is the ambergris put? It is an indispensable article with fine perfumes, as it is used to give permanency and lasting qualities to very fleeting scents. It is a curious fact that the keynote or basis of "nosegays," or "bouquets," as handerchief odors are called, is not, as one might suppose, the attar of garden flowers nor the penetrating balsams—these are indispensable, but are not the ground work. That basis is always one of the four animal odors, i. e., ambergris, musk obtained from small musk deer of Asia, civet from the civet cat of India, and castor, a secretion of the castor beaver and now almost obsolete in the perfume trade. The pure and separate tincture of any one of these odors is too intense and powerful to be tolerated. Like all substances of these kinds they must undergo a complete decomposition till the remainder possesses very little volatility. Even then they contain a virtue which clings pertinaciously to woven fabrics, and not being soluble in weak alkaline lyes is still to be detected in the material after passing through the several lavatory ordeals. They are, therefore, of great value to the perfumer, and are the essential foundation in almost every formula.

The essence of ambergris is obtained by mixing three ounces of it with one gallon of pure alcohol, and not till after a month is it ready for use. This, however, is only kept for mixing, and is far too strong. Only when it has entered in minute proportion into the bouquets does it produce those agreeable and characteristic perfumes, the effect of which upon the sensitive nose is much like the happy sensation produced by harmonious musical chords on the delicate ear, or the perfect blending of colors to the educated eye.

As ambergis is the most costly of the animal perfumes, the bouquets containing it are of the most expensive kinds. It is used more in France than in this country, civet being extensively used for a retainer in American made perfumes. Most of the ambergris is shipped therefore to France, where it finds a ready demand. Among the largest purchasers may be named the following: E. Coudray, Felix Prob (Lubin), Chevelot Freres, and Roger & Gallet, these being probably the largest perfumers in the world.

Perhaps it is owing to the costly combination or partly because it is exceedingly recherche that ambergris finds a prominent place in the favorite perfume of the Prince of Wales, and also in the famous "Eau de Chypre," a perfume introduced into Europe when at the time of the Crusades Richard I of England assumed the title of King of Cypress. The mixture under this name forms probably the most lasting odor known, as musk also enters into the nosegay. Scarcely less old is the "Bouquet de Montpellier," one of the most noted French perfumes, the original date of the formula for which is lost in history, being already old when it was given to a manufacturer of Montpellier, over a century ago. This exquisite scent has ambergris for its strong keynote, as does also the ointment which is used annually by the Pope in the ceremony of the blessing of the Golden Rose. After reciting Latin verses explaining the significance of the benediction, his Holiness takes the flower, which is made of the most valuable gold and ornamented with rare stones, and rubs it with ambergris, musk, and incense; after this impressive act mass is celebrated in the Sistine Chapel. What a purification is this for the deposit from the festering depths of the suffering whale!

I was led with much impressiveness one day of late into an underground vault in a large wholesale drug house of this city. Triple locks and bolts on several doors must be loosened before my guide, who was the head of the firm, could admit me. It was a tiny room, hardly more than a closet, and was made brilliant by a single gas jet. But what a mine of wealth was here represented! But there was no costly setting for this precious substance; uneven pieces of all forms and sizes lay about on the rough pine shelves, presenting no particularly interesting appearance. Indeed, they for the most part looked like lumps of dried clay, and a casual observer would never stop to pick them up in his pathway. One's curiosity is only excited after the intrinsic value becomes known. Some loosely collected in a wooden box looked like lumps of brown earth or wood mould. These specimens were of inferior quality and would not bring more than $5 an ounce.

But their odor was quite nauseating. The ambergris of more value was of a yellowish dull amber color—which probably gave it originally its name—and was in strata, as if it had accumulated during its morbid growth these definite layers.

But the larger part of the collection was of that beautiful squirrel gray—a hue that is a mark of great value—and of a smooth even grain, with streaks of black and yellow, its cut surface presenting a waxy appearance. On thrusting a hot needle into the mass a peculiarly fragrant odor is emitted. A piece shown no larger than the top of a child's head and of excellent quality has a value of $2,500, and in its bright gray segments could be seen deeply embedded the curious beaks of the cuttlefish, though many specimens were seemingly entirely free from them. In the closeness of the little apartment the sweet penetrating perfume became oppressive and acted on the senses with the effect of a narcotic, causing a languid sensation to steal over one.

[Continued from SUPPLEMENT, No. 1089, page 17411.]

THE MORE IMPORTANT INSECTS INJURIOUS TO STORED GRAIN.*

THE SAW-TOOTHED GRAIN BEETLE.

(Silvanus surinamensis Linn.)

THIS little beetle is widely distributed over the entire globe, and is of common occurrence in granaries, in groceries, in dwelling houses, and in barns, and, in fact, almost everywhere where edibles are stored. It is nearly omnivorous, infesting grain and seeds of all sorts, flour, meal, bran, screenings, breadstuffs, and other comestibles. It has been reported as specially injurious in different years in Michigan, Mississippi, Oregon, Delaware,

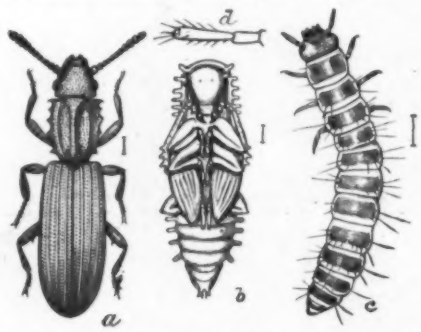


FIG. 7.—Silvanus surinamensis: a, adult beetle; b, pupa; c, larva—all enlarged; d, antenna of larva—still more enlarged (from Chittenden).

and other States, and has been the subject of a series of experiments at the Oregon and Delaware experiment stations.

The insect is a clavicorn beetle of the family Cucujidæ. It is very small, only about one-tenth of an inch long, slender, much flattened, and of a dark chocolate-brown color. The antennæ are clavate, and the thorax has two shallow longitudinal grooves on the upper surface and bears six sawlike teetb on each side, as shown at Fig. 7 a.

The larva, as will be noticed by reference to the illustration (c), has six legs. It is exceedingly active, and does not pass its life wholly within a single seed, but runs about nibbling here and there. After attaining its growth the larva attaches itself to some convenient surface and constructs a covering by joining together small grains or fragments of infested material by means of an adhesive substance which it secretes, and within this case the pupa (b) and afterward the adult states are assumed. From data acquired by experiment during the year it is estimated that there are six or seven generations of this insect annually in the latitude of the District of Columbia. During the summer months the life cycle requires but twenty-four days; in spring, from six to ten weeks. At Washington, it has been learned, the species winters over, in the adult state, even in a well warmed indoor atmosphere.

THE FLOUR BEETLES.

During the past year two little tenebrionid beetles, popularly known as "flour weevils," viz., Tribolium confusum and T. ferrugineum, have occasioned considerable alarm among millers, flour and feed dealers, grocers, and dealers in patent foods. The two species resemble each other so closely that it is only with the aid of a magnifying glass that a difference can be detected, and their habits are also very similar.

For many years these insects have been known in Europe as enemies of meal, flour, grain, and other stored products, and even as pests in the museums. Although they live in grain, their chief damage, probably, is to flour and to patented articles of diet containing farinaceous matter. The eggs are deposited in the flour, and the young larvæ, being minute and pale in color, are not noticed; but after the flour has been barreled or sealed up in boxes and left unopened for any length of time the adult beetles make their appearance, and in due course the flour is ruined. A part of the trouble caused to purchaser, dealer, and manufacturer is due to the fact that the insects are highly offensive, a few specimens being sufficient to impart a disagreeable and persistent odor to the infested substance.

In addition to the two species of Tribolium, there is another similar beetle that attacks grain, viz., the slender-horned flour beetle (Echocerus maxillosus), which will be mentioned hereafter.

The confused flour beetle (Tribolium confusum Duv.) is a minute, reddish brown beetle, elongate and de-

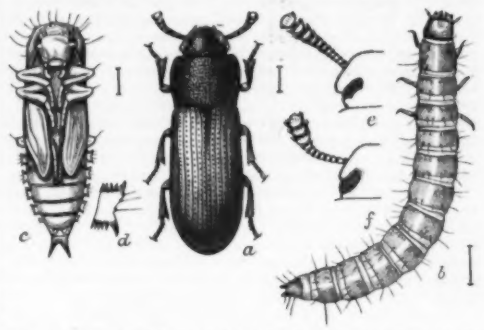


FIG. 8.—Tribolium confusum: a, adult beetle; b, larva; c, pupa—all enlarged; d, lateral lobe of abdomen of pupa; e, head of beetle, showing antenna; f, same of T. ferrugineum—all greatly enlarged (from Chittenden).

pressed, of the appearance represented in the illustration (Fig. 8, a), and the size indicated by the hair line. It is separable from ferrugineum chiefly by the structure of the antenna, which is gradually clavate, as may be seen at e. The head, it will be noticed, also differs from that of ferrugineum, shown at f. The general characters of the larva are illustrated at b, and the pupa at c and d.

From experiment during the year it was learned that this species, in an exceptionally high temperature, is capable of undergoing its entire round of transformations in thirty-six days, but in spring and autumn weather it requires a much longer time. In well heated buildings, at this rate, there are at least four, and possibly five, broods during the year.

The injuries reported of this species, as noted down in the records of the division, far outnumber those due to any other farinivorous insect. During the year the

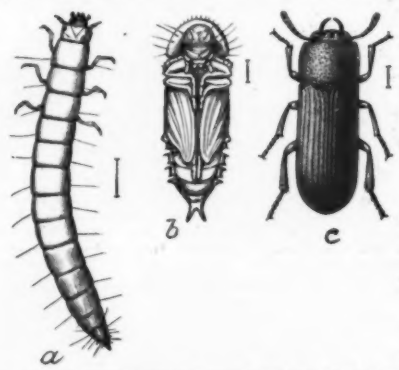


FIG. 8 a.—Echocerus maxillosus: a, larva; b, pupa; c, adult male—all enlarged (from Chittenden.).

species has been received in a patented food purchased at a local grocery, in wheat from New Mexico, in flour from Massachusetts, in oatmeal, in flour and meal from Indiana, and in corn, peanuts, and seeds. We have also notes upon its feeding upon snuff, orris root, baking powder, rice chaff, graham flour, red pepper, and upon dried insects. During August this insect was reported as very destructive in western Massachusetts to flour received from different sources in the West, having been the cause of extensive damage and much annoyance to the interested parties. A Western miller having dealings in the East stated that he had also been troubled with this insect at Portland, Me., Boston and New York.

The rust-red flour beetle (Tribolium ferrugineum Duv.) resembles in general appearance the preceding species, but may be distinguished by the antenna having a distinct terminal three-jointed club (see Fig. 8, f). The larva and pupa also strongly resemble those of confusum. Within the year it was found to have damaged two lots of imported cotton seed at the department. At the Columbian Exposition it was present in injurious numbers in most of the cereal exhibits from the tropics; also in cakes, yams, nuts, and seeds of many kinds. The species is widely distributed, and is common in the United States, parlicularly throughout the South.

The slender horned flour beetle (Echocerus maxillosus Fab.) has habits similar to those of the two preceding species, and is of common occurrence in the Southern States, where it lives on grain in the field as well as in the granary, and even under the bark of trees. This species is probably a native of tropical America, and although not positively known to have established itself north of southern Ohio, is gradually extending northward. It has recently been found in Washington breeding in shelled corn. It lives also in flour and meal.

This beetle resembles Tribolium, but is lighter in color and a little smaller, measuring a trifle over an eighth of an inch in length. On the head, between the eyes, are two pointed tubercles, and the mandibles in the male are armed with a pair of slender, incurved horns. The insect in its several stages is illustrated at Fig. 8a.

THE SQUARE-NECKED GRAIN BEETLE.

(Cathartus gemellatus Duv.)*

An insect of some importance in the South is the square necked or red grain beetle. It is undoubtedly identical with a European species, and in the United States occurs as far north as New York.

The beetle is of about the same length as the saw-toothed species, to which it is nearly related and some-

* By F. H. Chittenden, Assistant Entomologist, United States Department of Agriculture. Reprinted from the Yearbook of the United States Department of Agriculture for 1896.

* Some confusion exists in regard to the synonymy of this species. It is the Silvanus quadricollis Lec., and has been incorrectly referred to S. cassiæ Reiche.

what resembles; but the head and thorax are nearly as broad as the abdomen; the thorax is nearly square, not serrated on the sides, and the color is shining reddish brown.

This species has received special mention by Townend Glover (Pat. Off. Rept., 1854, p. 66), and is treated in bulletins on grain insects recently issued by the Mississippi and Maryland stations. It breeds in corn in the field as well as in cotton bolls, and continues breeding in harvested grain. The eggs are laid at the base of the kernels, into which the larvæ bore, and afterward complete their transformations. Glover states that corn injured by this species has little chance of germinating, as the germ is nearly always first destroyed, and that this fact may, in some degree, account for the numerous failures of seed corn to grow, of which Southern planters so often complain.

THE CADELLE.

(Tenebroides mauritanicus Linn.)

An account of the insect enemies of stored grain would not be complete without reference to Tenebroides mauritanicus, the larva of which is called by the French "cadelle." It has long been known to feed upon stored grain in Europe, where it is said to be extremely injurious. In this country it has never been reported as especially destructive, although of common occurrence everywhere in grain infested with other insects. It is not, however, so injurious as many of the preceding species, as its predaceous habits partially offset its destructiveness. The question has been raised as to whether or not this species fed upon stored grain, the claim being made that it was strictly predaceous. Experiments conducted by the writer prove that the larva not only feeds upon grain, but is capable of very serious injury to seed corn from the habit it has of devouring the embryo or germ, going from kernel to kernel and destroying many more seeds than it consumes. It is also predaceous, both in the larval and adult stages, and even destroys its own kind.

The adult cadelle is an elongate, oblong, depressed beetle of a dark brown color and about a third of an inch in length. The larva is fleshy and very slender, and measures when full grown nearly three-fourths of an inch. In color it is whitish, with a dark brown head. The three thoracic segments are also marked with dark brown, and the tail terminates in two dark, horny points.

REMEDIES.

The measures to be observed in the control of insects in stored grain are both preventive and remedial, but before taking up the consideration of the various remedies that may be used with more or less benefit, and the precautionary measures that may always be observed with profit, it should be borne in mind that we have in the bisulphide of carbon a nearly perfect remedy for all insects that affect stored produce.

A few words must be said in answer to a question that is often asked, viz.: What varieties of grain are the least susceptible to "weevil" attack? There is no weevilproof grain. Unhusked rice, oats and buckwheat are practically exempt, but unhulled barley is attacked with avidity. Husked, shelled or hulled grain is still more liable to attack. The soft varieties of wheat are greatly preferred, and the small, hard-grained varieties are little troubled with insects. Corn, when shelled, is more susceptible to the attack of most species than when on the cob, but appears to be preferred by the Angoumois moth in the latter condition. The hard, flinty varieties and such as have a closely fitting husk are not so liable to insect attack, and corn has been kept for years nearly exempt from infestation by this moth by being housed in the husk or shuck.

Exclusion of the Insects from the Granary.—The measures that may be observed to prevent the infestation of the grain are manifold. As has already been said in treating of the Angoumois moth, it is impossible entirely to prevent this insect from entering the grain in the field. The same is true to a limited extent of a few of the other species in the extreme South; still all but a very small percentage of damage from this source may be prevented, first, by harvesting as soon as the grain is ripe; second, by threshing as soon afterward as possible.

In the process of threshing, many of the infested kernels will be blown out with the chaff and dust and the insects killed by the agitation which the grain receives. The moths and many weevils are destroyed in the threshing, but the eggs, larvæ and pupæ, many of them, survive this treatment, and further measures are required for their destruction. In France, where the Angoumois moth is so injurious, a number of machines have been devised for the treatment of infested grain. Into these the grain is poured, and either revolved while exposed to heat or subjected to a violent agitation which kills the contained insects. A new machine for the destruction of grain insects in mills is figured and described in Insect Life (Vol. VII, p. 263).

Better, however, than these devices, simpler and less inexpensive, is the establishment of a quarantine bin, as nearly airtight as possible, in which the newly threshed as well as the infested or suspected grain may be placed, before being disposed of for more permanent storage, and fumigated with bisulphide of carbon according to the directions which will be given in the closing chapter.

Prevention of Infestation to Fresh Grain.—The next precaution to be observed is that the grain after threshing be not exposed to infestation from being placed in bins that contain infested grain, or even housed under the same roof with such grain.

The granary should be built at some distance from other buildings, and the rooms in which the grain is to be stored should be constructed so as to be as near verminproof as possible. The doors should fit tightly, the windows should be covered with frames of wire gauze to prevent the entrance of insects from without and the escape of those within to the fields, and the floors should be oiled, painted or whitewashed.

Before storing fresh grain in old bins that have been badly infested they should be thoroughly cleaned, all the old grain removed, and the floors, walls and ceilings brushed and scrubbed.

The natives of India store their wheat in airtight pits to preserve it from the rice weevil and condemn ventilation. In the colder countries of Europe and in North America, on the contrary, ventilation is practiced and with decided benefit.

The practice of storing grain in large bulk is also to be commended, as the surface layers only are exposed to infestation. This practice is particularly valuable against the moths, which penetrate only a few inches beneath the surface. Frequent handling of the grain by shoveling, stirring or transferring from one receptacle to another is also destructive to the moths, as they are unable to extricate themselves from a mass of grain and perish in the attempt. The rice and granary weevils, however, penetrate more deeply, and, although bulking is of value against them, it is not advisable to stir the grain, as it merely distributes them more thoroughly through the mass.

It is advisable to remove the surface layers before grinding.

Impractical, useless or unnecessary remedies are often recommended, and a few words concerning these may not be amiss, if only to point out the defects of such as are worthy of notice.

Repellants, Counter Odorants and Lure Traps.—On the hypothesis that insects are extremely sensitive to odors, the use of many aromatic substances has been recommended for deterring insects from entering the grain, in driving them from it, and as baits for luring them away. Among such substances are garlic, "jimson" weed, coriander, fennel, aniseed, hemp, larkspur, ivy, box, rue, lavender, tansy, hops, wormwood, elder and pecan flowers, China berries and twigs, neem leaves, tobacco leaves and stems, and oil of turpentine. Admitting that any of these are of substantial value, and this is doubtful, they must be used in tight receptacles and in large quantity to be effective.

Among substances that have been employed with more or less benefit are salt, powdered sulphur, naphthalene, camphor, pyrethrum, and air-slaked lime. These, when sprinkled about in tight bins, have been productive of beneficial results in keeping out insects. In the preservation of samples of all sorts of products subject to insect attack, naphthalene, either in crystal or in the form of "camphor tar" or "moth balls," is very extensively employed, and when used in airtight receptacles is an almost perfect preservative. It cannot be recommended for grain that is to be used for food on account of its powerful and permanent odor.

Heat and Cold, and Other Remedies.—Until the adoption of the bisulphide of carbon as a fumigant, heat was relied upon as the best agent in the destruction of these insects. It has been ascertained by experiment that a temperature of 140° F., continued for nine hours, literally cooks the larva and pupa of the Angoumois moth, and that a temperature of from 120° to 130° F., continued for four or five hours, is fatal. It has also been experimentally proved that wheat can be subjected to a temperature of 150° without destroying its germinating power.

Kiln drying, at a still lower degree of heat, has been found effective.

A low temperature is equally destructive, and in colder climates these insects may be successfully dealt with by stirring or turning the infested grain, or by filling the building with steam and then throwing open the windows of the building at night and exposing the insects to frost.

Tobacco, sulphur, chlorine, benzine, and naphtha have been recommended and tried as fumigants against grain insects, but none of them produce entirely satisfactory results, their vapor being insufficient for the destruction of the adolescent stages of our most injurious species, which breed wholly within the kernel, while all of these agents possess an offensive odor which is more or less persistent in the grain after treatment. The vapor of benzine and naphtha is also inflammable. Sulphur, properly applied, may be used with benefit in buildings where for any reason the use of bisulphide of carbon is not advisable, and steam and sulphur combined are very destructive to insect life.

THE BISULPHIDE OF CARBON TREATMENT.

The simplest, most effective and inexpensive remedy for all stored grain insects is the bisulphide of carbon. This is a colorless liquid with a strong, disagreeable odor. It vaporizes abundantly at ordinary temperatures, is highly inflammable, and is a powerful poison.

A number of methods for the application of the bisulphide of carbon have been suggested and tested, but the most effective manner of applying the reagent in moderately tight bins consists in simply pouring the liquid into shallow dishes or pans or on bits of cotton waste and distributing about on the surface of the grain. The liquid rapidly volatilizes, and, being heavier than air, descends and permeates the mass of grain, killing all insects as well as rats or mice which it may contain.

The bisulphide is usually applied in tight bins at the rate of a pound to a pound and a half to the ton of grain, and in more open bins a larger quantity is used. Mr. H. E. Weed, who has experimented with this insecticide in Mississippi, however, claims that 1 pound to 100 bushels of grain is amply sufficient to destroy all insects, even in open cribs. Bins may be made nearly airtight by a covering of cloths or blankets. Oilcloth and painted canvas are excellent for this purpose.

Mills and other buildings, when found to be infested throughout, may be thoroughly fumigated and rid of insects by a liberal use of the same chemical. A good time for fumigating an entire building is during daylight on a Saturday afternoon or early Sunday morning, closing the doors and windows as tightly as possible and observing the precaution of stationing a watchman without to prevent anyone from entering the building. It is best to begin in the lowest story and work up, in order to escape the settling gas. The building should then be thoroughly aired early Monday morning. The bisulphide is usually evaporated in vessels, one-fourth or one-half of a pound in each.

Certain precautions should always be observed. The vapor of bisulphide is injurious to all animal life, but there is no danger to a human being in inhaling a small quantity. It is also explosive, but with proper care that no fire of any kind, as, for example, a lighted cigar, be brought into the vicinity, no trouble will be experienced.

Infested grain is generally subjected to the bisulphide treatment for twenty-four hours, but may be exposed much longer without harming it for milling purposes. If not exposed for more than thirty-six hours its germinating power will be in nowise impaired. In badly infested buildings it is customary to repeat this treatment about every six weeks in warm weather.

Bisulphide of carbon is for sale at drug stores at from 20 to 30 cents a pound, but at wholesale, in 50 pound cans, it may be obtained at the rate of 10 or 15 cents a pound.

A grade known as "fuma bisulphide," for sale at 10 cents a pound, is said by experienced entomologists and others who have experimented with it to be much more effective than the ordinary grades on the market.

The cost of treatment is thus only 10 cents a hundred bushels.

MYSTERIOUS TOWERS.

A WITTY writer once said that the readiest way of testing the sanity or insanity of an Irish antiquary is to ask him his opinion as to the Round Towers. Certainly few archæological questions have excited greater controversy than that of their origin and use. The wildest theories about them have been advanced and supported with a great parade of learning, often thinly disguising the most audacious ignorance. A set of writers have ascribed the erection of the Round Towers to the Danes, either to serve as watch towers against the natives or, after their conversion to Christianity, as belfries. These writers are undeterred by the fact that there are no similar towers in Denmark. Others have argued that they were built as "gnomons" for making astronomical observations and determining the equinoxes and solstices, as well as for preserving the Druidical fire. The former part of this theory was mainly based on a mistranslation of the word fidhnemed, which occurs in the Irish "Annals," and which was supposed to mean "celestial index," and to refer to the Round Towers, whereas Petrie, in a brilliant passage, has conclusively shown that it has no such reference, but means "sacred wood," or "wood of the sanctuary." Finally, many advocates of the pagan theory, driven from one position after another, on the strength of evidence showing that human remains have been found in or under some of the towers, have concluded that they were erected as sepulchral monuments in pagan times. The evidence under this head was, when Petrie wrote, somewhat vague and inconclusive, but since then the interiors of a number of Round Towers, especially in Ulster, have been carefully excavated, and though the results do not support the theory that the towers were erected as sepulchral monuments, yet, as they are sufficiently remarkable, and have not received the attention at the hands of Dr. Petrie's followers that they deserve, we may as well briefly notice them here.

The presence of human bones among the rubbish that has accumulated within the towers may be accounted for by the habit of throwing in bones turned up in digging graves in the immediate vicinity. In other cases, as at Kilkenny, when interments (from their position with the feet to the east presumably Christian) were found underneath the foundations of the tower, the natural inference is that the graveyard which surrounds the tower had been used as such before the tower was built. In some six or eight cases, however, interments have been found within the circuit of the foundations under circumstances pointing to their having been made while the tower was being built. A little above them has generally been observed what has been called a "lime floor," which was probably formed of the mortar accidentally dropped during the building of the tower. Sometimes the remains consisted of one or more skulls and other bones lying without any order or regularity, and in such cases it is a possible theory that the builders reverently reinterred such bones as were displaced in digging the foundations; but in at least four cases a skeleton was found complete, or nearly so, with the bones lying in the natural order, and in these cases the conclusion is almost inevitable that a body, and not loose bones, was interred at the time the tower was built. In one exceptional case, namely, at Trummery, County Antrim, where the Round Tower appears to have been added to an existing church, a sort of rude chamber or cist was found immediately underneath the tower containing a skull and other parts of a skeleton. From the position in which the remains lay it was evident either that the body had been barbarously dismembered or that the bones had been removed from some previous depositary to be reinterred here. These are facts which have to be accounted for.

With regard to these interments, it has been suggested with much probability that the chieftains who erected the towers for the protection and use of the church may have taken advantage of the opportunity to inter within their precincts the honored remains of some one or more of their departed kindred. It is well known that founders and benefactors of churches have made similar arrangements, but in neither case would it follow that the buildings, though used as sepulchers, were erected as sepulchral monuments. More recently Mr. Hodder M. Westropp has found a resemblance between them and the Fanaux de Cimetière, or beacons of the cemetery, to be found in certain parts of France, from which he infers that "the Irish Round Towers derive their origin from France, and that they were erected in cemeteries as memorials of the dead, and were used as beacons to guide funeral processions to the churchyards, the light in the tower serving also as a signal to recall to the passers-by the presence of the departed, and calling on them for their prayers." It is not impossible that the Round Towers may have subserved some such secondary purposes, though we do not hear of funerals taking place at night; but the important part of this speculation, viz., that the Irish towers derived their origin from the Fanaux de Cimetière of France, has little to support it. There is little in common between the two classes of edifices, and the fanaux were much smaller and appear to have been later in date. Finally, the Rev. Richard Smiddy, writing as recently as 1871, says that the native Irish word for the Round Tower is cuileach; that this word means reed house; that the reed which was taken as the model of the Round Tower was the emblem of John the Baptist—"a reed shaken by the wind"—and of water, and that the towers were constructed and used as baptistries!

Let me briefly describe the Round Towers in general terms. There exist or are known to have existed in Ireland at least 100 examples. Eighteen of these may

be classed as still perfect, or nearly so. About as many more have entirely disappeared, but their former existence is well authenticated. The rest, including those of which only the foundations remain, exist in various stages of ruin. The large majority of them stand detached from any other building, but some nine or ten were structurally connected with a church. Besides these, there are, or were, two in Scotland, seven in the Orkney, Shetland, and Faroe Islands and one in the Isle of Man. These latter may be regarded as outlying members of the Irish group. There are, moreover, a few Round Towers in Italy, Germany, Belgium, and France, which present a considerable resemblance to the Irish type, and are believed to belong to the same period, or at least to be the outcome of the same movement. We shall have something to say about these by and by, but for the present we may exclude them from consideration. The average height of the isolated Round Towers when perfect was probably about 100 feet. The average circumference at the base is about 50 feet, the thickness of the walls at the door level about 3 feet 6 inches, and the height of the door above the ground about 12 feet. The tower at Kilmacduagh, County Galway, is the largest example remaining. Though it has lost its conical cap and part of the upper story, it is still 120 feet high, with walls 4 feet 4 inches thick, and the doorway is placed as much as 26 feet above the ground. The towers generally start from a projecting base consisting of one or more plinths, diminish slightly in circumference all the way up, and terminate, when perfect, in a conical cap. The interior is divided into stories from four to eight in number, according to the height of the tower. These stories are in general marked by offsets in the masonry, or by corbels, or by holes to receive the joists. The floors appear to have been usually of wood, though in at least three cases, at Castledermot, Meelick and Kinneigh, the lowest floor is of stone. In the top story there are generally four apertures, but there are examples in which two, five, six, and eight are found. There is generally a single window, variously placed, in each of the other stories; one of exceptionally large size is often found directly over the doorway.—Goddard E. Orpen, in the Leisure Hour.

THE OLDEST COLLEGE IN THE WORLD.

LUDGATE MONTHLY.

EL AZHAR—"The Most Splendid"—like most theological universities, has a turbulent reputation. At the beginning of the Fatimite Whalifate, in 970—when Moezz conquered Egypt from the northwest, aided by Sicilian Saracens, and founded El Kahirah of to-day—this was the first mosque that he erected. William the Conqueror had not at that time been born, and Saladin's grandfather was a baby. It took two years to build, and was endowed ten years later. What it resembled in those earlier days of Mohammedan supremacy nothing definitely shows to-day, but indications of its splendor are given by the tradition that Saladin took therefrom a silver rail weighing 500 drachms, while the terms of admiring adulation employed by contemporary Arab historians would show that it was even then the center of Moslem learning—the Oxford of the East.

In 1302 an earthquake shattered the fabric, and decay and neglect necessitated its subsequent restoration on three several occasions, so that the mosque of to-day has but little more originality than the armhole in the Irishman's oft-mended vest. But despite earthquakes, the war tumult, and inattention, it grew and prospered through the ages. It stood there while the lion-hearted Richard forgathered with his paynim rival—while all that we regard as English history was occurring; the mad Khalif Hakem, whom the mysterious Druses worship as the last of the messiahs, repaired and endowed it, and granted to its Ulema the exclusive privilege of repeating the Litany; it was "the kernel of the erudition of the Arabs." Of science it taught nothing, save that the earth was flat. For successive centuries it attracted disciples from each of the three continents then known, and nearly every Oriental notable in history, from the tenth century down to Arabi Pasha's day, imbibed learning and fanaticism at that font.

A writer who saw it in Mehemet Ali's time describes it as having then (as now) seven gates, leading to the quarters allotted to the Syrian, Moorish, upper, eastern, western and northern Egyptian students. Up to 1840 the doors always stood open, and it was a veritable Alsatia—a sanctuary for robbers and murderers. The civil authorities had no jurisdiction over the ten thousand inmates. But Mehemet Ali soon changed all that: experience of the danger of such an imperium in imperio had been shown during the period of Napoleonic occupation, when a revolt was organized there, which was only quelled by the bombardment of the mosque from the neighboring heights of the Mokatham range and the execution of twelve men every night for some time thereafter. In El Azhar the assassin of brave General Kléber had been sheltered and assisted, and for that crime three of the sheikhs lost their heads. Mehemet Ali purged the Augean stable considerably, abolishing its priestly jurisdiction and annexing a considerable share of the great properties with which it had been endowed during the lapse of eight centuries. But it is still a center for the lazy, and lawless, and turbulent, attracted by its shady cloisters and its dole of bread, rather than the quaint architecture, the squalid tombs of noted shereefs, or the useless teaching which forms the unchanged curriculum of this the greatest of all Moslem universities.

European visitors need to be enthusiastic newcomers to the East, or ardent admirers of things Oriental, not to feel disappointed after a pilgrimage thither. The approaches—narrow, tortuous, half ruined lanes—prevent the great building being taken in at one coup d'œil, and the result is that on the compulsorily close inspection the tall minarets are seen to be only tawdry, chimneyfied shafts of comparatively late date, the wood carving perishing if at all "antika," and coarse, if modern; the chapels containing the shrines are in the hands of the whitewashers; the library is a dismal array of empty cases; and the picturesque lamps of classic form that used to hang from every beam are vanished—swept away in favor of gas! In the summer the attendance is naturally much smaller than at other seasons, as, though there is nothing in the way of a regular vacation, many of the habitués spend the hotter months in revisiting their families in the neighboring countries. This year, owing to the closing for one year of the Syrian section by the government, as a punishment for a riot, the place seemed even more deserted than usual, the matted pavement being given up to a few sleeping loafers, and a score or two of young scribes engaged in covering their tin "slates" with scrawly texts dictated by their teachers. Around the walls were rows of lockers wherein the collegians kept their worldly belongings, an old gown or two, a few pots, and some dog's-eared lesson books. The cicerone was not very communicative: apparently only the prospect of a tip and the fact that we had fivepenny tickets for admission, restrained him from starting to eject us. All the information he could distill was that this and that was "antika;" he pointed with pride to the buttonholes in the great gate and hurried us past the only really artistic object, the pulpit, near which a group of the faithful were going through that athletic exercise which accompanies their devotions. The chief interest was really evoked by a survey of the human element, and the reflection that this swarthy Soudanese and yonder Moor from Northwestern Africa, the sallow Arab from beyond Yemen, talking to a co-religionist from some oasis far out in the Libyan Desert, had all been drawn to that common focus, despite the cost, the toil, and the no small peril of the journey, by a yearning for more light. Without the compulsion of a school board, or the hope of a well paid fellowship, they came from afar, presented themselves with simple confidence that room would be found for the mat which was their schoolroom, living place and bed, and that an unfailing dole of bread and water would be daily forthcoming—that Spartan fare which feeds fanatics.

Thirty generations had so come and gone, searching whatever the late Khedive believed to exist in El Azhar—a "vast pillar of light, visible at night, reaching from the earth to the heavens. Round the fountains may be seen the spirits of holy men who come down to make ablution. In another part of the mosque, among the forest of many columns, a man whose heart is pure can behold little children in the form of elves or fairies, playing about in the dust, laughing, running and making all kinds of wild antics. These little elves are said to live in the large boxes ranged around the walls, which belong to the students."

HOW TO FIND A GIVEN DIRECTION WITHOUT A COMPASS.

ABOUT sixty years ago, in the plains of La Beance, it is said that the following wager was made: Without other guide than the sun, a chasseur furnished with a large watch was to reach a rendezvous, not visible, situated exactly twenty-four kilometers (fifteen miles) from his starting point, and in a northwesterly direction, making an angle of forty-five degrees with the meridian, very exactly measured. The wager was to be considered lost if the one who made it should not reach a point within 1,000 meters (a little over half a mile) of the given place. The wager was won. (It was in October.)

Is it since that time that, in the course of instruction in orientation given to military cadets, it has often been said that a good watch may take the place of a compass. I do not know. It is a fact, however, that the following rule is laid down: To determine the direction of the meridian, place the watch horizontally and direct the hour hand toward the sun; the line bisecting the horary angle will point south. This process was perhaps recommended when the compass was a relatively dear instrument, not common in a portable form; but, ingenious and simple though it may be, it is inapplicable when the sun cannot be seen. We may suppose that nowadays, when for three francs one may buy a small compass as easy to carry as a watch, no one would take the trouble to ask to what degree of approximation one might obtain his true direction with a watch and the sun. Bidden to defend the process that he taught to the cadets, a lieutenant, in garrison at Châlons, proposed the following proof: Required: to start from one of the boundaries of the camp, walk nine kilometers (five and a half miles) in a straight line, about face, and return to the starting point. Anyone returning within 800 meters (half a mile) of the starting point, marked by a small stake, to be considered as having won.

Let us note the results obtained on June 20, each contestant being given free choice of his hour of departure. Of two contestants on foot, having traversed eighteen kilometers (eleven miles), one won, the other lost, his error being six kilometers (three and a half miles). Of two contestants on horseback, being required to traverse twice this distance, or thirty-six kilometers, one returned within 1,300 meters (three-quarters of a mile) of the starting point; the other went entirely astray, his total lateral error exceeding ten kilometers (six and a quarter miles). Such a wide difference between results was sufficient to cause doubt at once of the aptitude of the losing contestants; nevertheless, all had proceeded correctly. The variation in the four results is explained by the choice of hours. The two losers, being desirous of lunching with their comrades, made their journey between 6 and 10 a. m. The two winners, starting later, lunched in the middle of their route. They traveled the first half from 8:30 to 10:30 a. m. and the last half from 1:30 to 3:30 p. m. Without having made a specialty of gnomonics, they had doubtless remarked that with respect to the meridian the morning shadows are symmetrical with those of the afternoon, and they had wisely concluded that if in the morning they should deviate to the right, they would deviate to the left in the afternoon. They therefore rightly arranged the time of their expedition so that noon divided the whole period equally and also divided equally the time of rest between the two halves. —Cosmos.

Pyoctannate of Mercury.—It is prepared by treating a solution of pyoctannin with a solution of mercuric chloride and ammonium chloride. It is employed in favus and chronic gonorrhœa in ⅛ to 1 per cent. solution; it may also be used on a succedaneum of iodoform.—Pharm. Zeitung.

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